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REPORT OF THE AD HOC COMMITTEE ON THE PEACEFUL USES OF OUTER SPACE

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NOTE BY THE RAPPORTEUR

1. By resolution 1348 (XIII), of 13 December 1958, the General Assembly established an Ad Hoc Committee on the Peaceful Uses of Outer Space consisting of the representatives of Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, France, India, Iran, Italy, Japan, Mexico, Poland, Sweden, the Union of Soviet Socialist Republics, the United Arab Republic, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

2. The work of the Ad Hoc Committee was conducted at United Nations Headquarters in New York. It began on 6 May and concluded on 25 June 1959.

3. The representatives of the following States took part in the work: Argentina, Australia, Belgium, Brazil, Canada, France, Iran, Italy, Japan, Mexico, Sweden, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

4. The Committee elected the following officers:

Chairman: Dr. Koto Matsudaira (Japan);
Vice-Chairman: Dr. Mario Amadeo (Argentina);
Rapporteur: Mr. Joseph Nisot (Belgium).

5. The Committee established two committees of the whole, one technical under the chairmanship of Dr. D.C. Rose (Canada), and the other legal under the chairmanship of Prof. Antonio Ambrosini (Italy). The Technical Committee prepared the report on paragraph 1 (b) and the Legal Committee the report on paragraph 1 (d). At the request of the Ad Hoc Committee, the Secretary-General presented a report covering paragraph 1 (a) of the General Assembly resolution which constituted the basis for the Committee's report on that paragraph.

6. The Ad Hoc Committee and its committees of the whole have held twenty-five meetings. They were given valuable assistance by the United Nations Secretariat, especially by Dr. Sanford Schwarz, Secretary of the Ad Hoc Committee and of the Technical Committee, Mr. Oscar Schachter, Secretary of the Legal Committee, and Mr. Geoffrey S. Murray, the representative of the Secretary-General.

7. By the terms of resolution 1348 (XIII), the Ad Hoc Committee was required to report to the General Assembly on the four following matters described in paragraph 1 of the resolution:

"(a) The activities and resources of the United Nations, of its specialized agencies and of other international bodies relating to the peaceful uses of outer space;

"(b) The area of international co-operation and programmes in the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices to the benefit of States irrespective of the state of their economic or scientific development, taking into account the following proposals, inter alia:

(i) Continuation on a permanent basis of the outer space research now being carried on within the framework of the International Geophysical Year;

(ii) Organization of the mutual exchange and dissemination of information on outer space research;

(iii) Co-ordination of national research programmes for the study of outer space, and the rendering of all possible assistance and help towards their realization;

"(c) The future organizational arrangements to facilitate international co-operation in this field within the framework of the United Nations;

"(d) The nature of legal problems which may arise in the carrying out of programmes to explore outer space."

8. Each of these four matters is the subject of a separate part of the present report, which the Ad Hoc Committee adopted unanimously on 25 June 1959:

Part I:	paragraph 1 (a)
Part II:	paragraph 1 (b)
Part III:	paragraph 1 (d)
Part IV:	paragraph 1 (c).

PART I

(PARAGRAPH 1 (a) OF GENERAL ASSEMBLY RESOLUTION 1348 (XIII))

1. The Ad Hoc Committee on the Peaceful Uses of Outer Space, at its first meeting on 6 May 1959, requested the Secretary-General to prepare a report on the subject matter of paragraph 1 (a) of General Assembly resolution 1348 (XIII), namely, "The activities and resources of the United Nations, of its specialized agencies and of other international bodies relating to the peaceful uses of outer space". On 16 June, the Secretary-General submitted a comprehensive and valuable report (A/AC.98/4) to the Committee on these matters, which stands as a part of the documentary records of the Committee.

2. The present part I is based on the Secretary-General's report. The Committee has sought to summarize the pertinent data in such a way as to facilitate future United Nations discussions relating to the peaceful uses of outer space.

I. INTERNATIONAL SCIENTIFIC ORGANIZATIONS

A. The international scientific unions

3. The principal non-governmental international bodies which are interested and active in space research are the international scientific unions in the several major fields of science which benefit by experiments utilizing sounding rockets, satellites, and space probes. These are:

International Astronomical Union (IAU)
International Union of Geodesy and Geophysics (IUGG)
International Union of Pure and Applied Chemistry (IUPAC)
International Scientific Radio Union (URSI)
International Union of Pure and Applied Physics (IUPAP)
International Union of Biological Sciences (IUBS)
International Union of Theoretical and Applied Mechanics (IUTAM)
International Union of Physiological Sciences (IUPS)
International Union of Biochemistry (IUB)

4. The International Union of Mathematics (IUM) has also expressed some interest. The interests of the remaining three international scientific unions, i.e.

International Geographical Union (IGU), International Union of Crystallography (IUCr) and International Union of the History of Science (IUHS) lie outside the space field.

5. The objects of the unions are:

(a) To promote the study of problems relating to their scientific fields;

(b) To initiate, facilitate and co-ordinate research into, and investigation of, those problems which require international co-operation;

(c) To provide for discussion, comparisons and publication.

6. The unions are maintained by the voluntary, part-time work of a small group of active scientists elected for limited terms. The administration is small and flexible. The activities are directed toward organizing meetings ranging in size from small symposia on specialized topics to large congresses devoted to all aspects of the whole discipline, and in maintaining or encouraging publications.

7. The unions maintain contact with scientists in the various countries through national committees or equivalent bodies, one for each discipline. Annual national contributions to the unions are paid by the national committees, the total for all thirteen unions amounting to between $150,000 and $200,000 per year. The national committees are often organized by or related to the national academies or research councils in the respective countries.

B. The International Council of Scientific Unions

8. The establishment of the International Council of Scientific Unions (ICSU) in 1931 provided a central organization to deal with problems of common interest and to encourage international scientific co-operation.

9. Further objects of the Council are:

(a) To encourage international scientific activity in subjects which do not fall within the purview of any existing international organization;

(b) To enter, through the national adhering organizations, into relations with the Governments of the countries adhering to the Council in order to promote scientific investigation in these countries;

(c) To maintain relations with the United Nations and its specialized agencies;

(d) To make such contacts and mutual arrangements as are deemed necessary with other international councils or unions, where common interests exist in the field of the natural sciences covered by the Council.

10. The General Assembly of ICSU consists of representatives of the thirteen scientific unions and of national representatives from the national academies or research councils of the forty-five countries adhering to ICSU. The Assembly meets triennially and elects an Executive Board, which meets annually. There is an administrative office in The Hague with a small full-time secretariat.

11. The financial resources of ICSU consist of contributions from the national adhering bodies amounting to about $50,000 per year and an annual grant of about $200,000 from the United Nations Educational, Scientific and Cultural Organization (UNESCO) to support the scientific activities of the unions.

12. There are always a certain number of tasks which lie on the borderline between two or more unions. The Council takes special care to fill needs for co-operation or joint activities involving the disciplines of several unions or many national academies. Typical examples are the International Geophysical Year, Antarctic Research and Space Research. The Council copes with these tasks as they arise in international scientific life by the formation of special committees, such as the Special Committee for the International Geophysical Year (CSAGI), which was formed in 1953 and will continue to the end of June 1959, the Special Committee on Oceanographic Research (SCOR), first established in 1957, and the Special Committee on Antarctic Research (SCAR), 1958.

C. The International Geophysical Year

13. The activities of ICSU in space research began as a part of the programme of the Special Committee for the International Geophysical Year (CSAGI).

14. At a CSAGI conference in Rome, in 1954, a resolution was passed urging that as many nations as possible consider the development of satellites carrying scientific instruments, which would be placed in orbits around the earth during the International Geophysical Year. The resolution stated:

> "In view of the great importance of observations during extended periods of time of extra-terrestrial radiations and geophysical phenomena in the upper atmosphere, and in view of the advanced state of present rocket techniques, CSAGI recommends that thought be given to the launching of small satellite vehicles, to their scientific instrumentation, and to the new problems associated with satellite experiments, such as power supply, telemetering, and orientation of the vehicle."

15. Within a year, both the United States and the USSR indicated their intention to launch satellites. Successively, attention was devoted by CSAGI to the several phases of the earth satellite-tracking programmes. Special emphasis was placed on the need for wide international co-operation in tracking satellites to develop their full scientific potential. Many nations indicated a willingness to set up satellite observation stations.

16. Being non-governmental in organization, and with limited financial resources, CSAGI achieved great success through the voluntary co-operation of the participating national committees. Particularly in the rocket and satellite programmes, the financial and logistic support of the programme by the several national governments was essential.

17. With the termination of the International Geophysical Year, there was a wide-spread desire to continue international co-operation in the planning and co-ordination of space research as well as other activities of the year. This led to a programme of International Geophysical Co-operation 1959 (IGC) and to the formation of several special committees, including a Committee on Space Research (COSPAR).

D. The Committee on Space Research

18. The Committee on Space Research (COSPAR) was established, provisionally for an initial period of one year ending 31 December 1959, by a resolution of the eighth General Assembly of ICSU (Washington, D.C., 2-6 October 1958). The resolution stated that the primary purpose of COSPAR was "to provide the world scientific community with the means whereby it may exploit the possibilities of satellites and space probes of all kinds for scientific purposes, and exchange the resulting data on a co-operative basis".

19. The Committee is concerned with scientific research in the broadest sense. This is made clear by the provisional charter according to which the Committee shall promote fundamental research on space, on an international scale, but shall not normally concern itself with such technological problems as propulsion, construction of rockets, guidance and control. This objective shall be achieved through the maximum development of space research programmes by the international community of scientists working through ICSU and its adhering national academies

and international scientific unions. The Committee shall report to ICSU those measures needed in the future to achieve the participation in international programmes of space research of all countries of the world with those which are already actively engaged in research programmes within the domain of COSPAR.

20. The Committee's composition has been provisionally established to consist of:

(a) The representatives of national scientific institutions of the seven countries launching satellites or having a major programme in rocket research;[1/]

(b) The representatives of the national scientific institutions of three of the countries involved in tracking or other forms of space research on an agreed system of rotation;

(c) The representatives of nine international scientific unions.

21. The Committee has held two meetings to date, an organizational meeting in London in November 1958 and a second meeting at The Hague in March 1959. The actions taken may be summarized as follows:

22. All the countries that had taken part in the rocket and satellite programme of the International Geophysical Year, namely, Australia, Canada, France, Japan, the Union of Soviet Socialist Republics, the United Kingdom and the United States were admitted to membership under group (a) mentioned in paragraph 20 above. India, Peru and the Union of South Africa were invited as the first rotating members under group (b), but only the Union of South Africa accepted and was present at the second meeting. Group (c) contains the representatives of the nine unions previously listed as interested and active in space research.

23. Three continuing working groups were established as follows: (1) Tracking and Transmission of Scientific Information; (2) Scientific Experiments (including biological experiments); (3) Data and Publications. Ad hoc committees were established to consider matters relating to experiments with biological implications and contamination by atomic explosions.

1/ These seven institutions (Australia, Canada, France, Japan, Union of Soviet Socialist Republics, United Kingdom and United States) contributed or were to contribute the $55,000 making up COSPAR's budget.

24. The task of the Working Group on Tracking and Transmission of Scientific Information is to: (a) delineate problems that may exist in this area; (b) propose and facilitate specific working arrangements for and among operating networks; (c) study the compatibility of frequencies, equipment and problems of radio interference. Among the matters of concern to this working group are methods whereby tracking systems can obtain "acquisition data" in time to permit tracking of space probes and satellites by the tracking equipment; problems of synchronizing observations on different networks; telemetry techniques; and the continuing need for optical as well as radio tracking. In connexion with point (c) above, the working group has not been called to assume responsibility for requesting frequency allocations, but it will work to ensure adequate and timely action through existing organizations responsible for such activity (International Telecommunications Union and International Radio Consultative Committee).

25. The task of the Working Group on Scientific Experiments is to: (a) evaluate scientific experiments submitted by countries which do not have facilities for launching space vehicles in order to determine the scientific desirability and feasibility of incorporating them in some form of space vehicle; (b) draw attention to fields of research not receiving sufficient emphasis, which might profitably be investigated through use of space vehicles; (c) arrange for co-ordinated activities by participating countries.

26. The task of the Working Group of Data and Publications is to study the need for various forms of data exchange and for the publication of results, continuing in this connexion the use of existing world data centres and arranging for the continued operation of any recommended means for such publication and exchange.

27. The Committee further recommended that COSPAR should: (a) inform all participating committees engaged in rocket programmes about the purposes of a proposed series of "rocket weeks", requesting suggestions and proposals for scheduling such co-operative groups of firing, including specific suggestions for a first such Rocket Week to be held in November 1959; (b) inform the same participating committees of the United States offer to undertake the launching into space of suitable and worthy experiments proposed by scientists of other countries.

28. At COSPAR's second plenary meeting, in March 1959, delegates from Australia, Canada, France, Japan, the Union of South Africa, the Union of Soviet Socialist Republics, the United Kingdom and the United States reported on the programmes being carried out by their respective national scientific institutions.

29. The Soviet delegate, illustrating the status of space research in the Soviet Union, divided the primary scientific tasks of space research into three categories: (a) study of the phenomena occurring on the earth and in the upper atmosphere and the influence of cosmic rays; (b) the properties of cosmic space as a medium in which man has to work and to travel; (c) the study of the phenomena on the planets and the stars which are impossible to observe from the earth's surface as the result of interference by the earth's atmosphere. The research in the upper parts of the atmosphere and in outer space was being continued by the Soviet Union. The rocket would be used as a routine means of studying the upper atmosphere; their number and the number of launching places would be increased. Satellite research would be continued, including experiments of a biological and astrophysical nature.

30. At the same meeting, the United States delegate stated that, although the scientific planning was still in its preliminary stages, it was hoped that in each of the next two years between 75 and 100 sounding rockets might be launched in the United States and approximately one or two satellites or space probes every two months. In the rocket-sounding programme, emphasis would be placed on experiments relating to atmospheric structure; electric and magnetic fields; astronomy; energetic particles in the ionosphere. The satellite programme would emphasize atmospheres; ionospheres; astronomy; energetic particles; electrical and magnetic fields and gravitation. Space probes would investigate energetic particles, fields and ionospheres. In each case, the objectives were set out in detail and the planned programme was outlined separately for the long-range and for the immediate future.

E. Other international organizations

31. The following international organizations are non-governmental, but they are not affiliated with ICSU.

32. The Council for International Organizations of Medical Sciences (CIOMS) has a professed interest in the medical aspects of manned space flight, a subject whose

research interests are also represented during the present preliminary stages by the International Union of the Physiological Sciences, represented in ICSU and in COSPAR.

33. The Union of International Engineering Organizations (UATI) and several of its constituent organizations have a potential interest in the progress of space research.

34. The International Astronautical Federation (IAF) was founded in 1950 by representatives of a number of national societies interested in rocketry and space exploration meeting in the first International Astronautical Congress. The constitution of the IAF, adopted in 1952, states that the purposes of the organization are to promote and stimulate the achievement of space flight as a peaceful objective, to secure the wide-spread dissemination of technical information, to stimulate public interest in space flight through the major media of mass communication, and to foster research and development.

II. INTER-GOVERNMENTAL ORGANIZATIONS

A. United Nations

35. As with other problems in international political co-operation and international economic and social collaboration among its Members, the ground on which the activities and resources of the United Nations in this field rest is the provision in Article 1, paragraph 4 of the Charter that the United Nations shall be a centre for harmonizing the actions of its Members in attaining their common ends, and the pledge given by Members in Article 56 "to take joint and separate action in co-operation with the Organization for the achievement" of solutions of international economic, social, health, cultural and educational problems. The General Assembly, the Economic and Social Council, and their subsidiary organs, as central organs for harmonizing the actions of Members, have developed international co-operative activities in fields affected with a scientific interest.

36. The Secretary-General has similarly used his functions to promote co-operation among Governments. In this he has sometimes acted on his own initiative and sometimes in response to requests from the General Assembly, asking him to make studies, to take procedural steps or, in some cases, to make proposals.

37. There are other areas of United Nations activity to which developments in the peaceful uses of outer space are relevant. These lie in the domain of promotion of the economic, social and cultural development of States and in the progressive development of international law. The Economic and Social Council is concerned with major inventions or technological improvements which affect existing patterns of economic and social activity. The progress anticipated in the near future in outer space in the fields of meteorology, climatology, telecommunications, transport, and possibly biology, is important from the standpoint of long-range economic policies.

38. One of the more important functions of the Organization is to assist in co-ordinating the activities of the specialized agencies. In this capacity, through the Economic and Social Council, it follows the work of the specialized agencies and assists in inter-agency co-ordination, at the Secretariat level, through the Administrative Committee on Co-ordination and its Preparatory Committee.

39. Of relevance also is the function of the General Assembly under Article 13 of the Charter to initiate studies and make recommendations for the purpose of encouraging the progressive development of international law and its codification.

B. United Nations Educational, Scientific and Cultural Organization

40. In accordance with its constitutional responsibilities, UNESCO has, since its inception, undertaken as one of its major tasks to promote scientific co-operation between its Member States. In doing so, UNESCO has worked in the closest collaboration with the United Nations, the specialized agencies and the International Atomic Energy Agency (IAEA). To this end the General Conference, at each of its sessions, has included in the regular programmes of the Organization a resolution relating to the promotion of scientific research through international co-operation. The relevant resolution in the programme for 1959-1960, adopted by the General Conference at its tenth session (November-December 1958), reads as follows:

> "10C/Resolution 2.41: The Director-General is authorized, in co-operation with the United Nations, the specialized agencies, and other appropriate international organizations and national and regional research bodies, on the advice of advisory committees when appropriate, to study scientific problems, the solution of which may help to improve the living conditions of mankind, to stimulate research on these problems and to promote when appropriate the adoption of international or regional measures for the development of such research, particularly in the following fields:
>
> (a) General problems of scientific research;
> (b) Humid tropical zone;
> (c) Marine sciences;
> (d) Cell biology;
> (e) Basic research in nuclear physics;
> (f) New sources of energy;
> (g) Numerical processing of information and electronic computation;
> (h) Interdisciplinary brain research; and
> (i) Exploration of extra-terrestrial space; and
>
> to participate in the activities of member States, at their request, in scientific research in the fields of humid tropics research, marine sciences, basic research in nuclear physics, and the numerical processing of information and electronic computation."

41. In the past, UNESCO has carried out a programme of this type either by drawing up practical proposals to be implemented by groups of member States, or by assuming direct responsibility for international scientific research projects.

42. In fulfilling its scientific functions, UNESCO resorts to a number of methods:

(a) Co-operation with international non-governmental scientific organizations. UNESCO has created, or sponsored the creation of, international non-governmental organizations, such as the Union of International Engineering Organizations and the Council of International Medical Organizations. Special mention should be made of the collaboration between UNESCO and ICSU. An agreement between the two organizations, signed in 1951, provides that they will assist one another with a view to facilitating the execution of their joint programme in the field of international scientific co-operation, and that they shall consult each other on all questions falling within their common sphere of interest. UNESCO has undertaken to grant ICSU an annual subvention designed to facilitate the co-ordination of the activities of the Council's member organizations and to provide funds for such scientific projects included in the programme of ICSU as are of international interest and in line with UNESCO's aims. ICSU has undertaken to give specialized advice to UNESCO, at the latter's request, on the planning of its programme in the field of international scientific co-operation, and to advise UNESCO on its working relationship with the non-governmental organizations within its field. It has further undertaken to give particular attention to, and to develop to the utmost, those of its programme activities which come within the framework of UNESCO's basic programme.

(b) Organization of international scientific conferences on important new subjects which are not yet being dealt with by international governmental or non-governmental organizations and of symposia on specific subjects related to the implementation of UNESCO's programme.

(c) Programme of co-ordinated research, surveys, training, etc., carried out with the help of special advisory committees composed of leading scientists and representatives of international scientific unions.

43. Mention should also be made of the Provisional International Computation Centre (PICC) established by a bilateral agreement concluded in September 1957 between UNESCO and the Italian Institute of Higher Mathematics (Istituto Nazionale di Alta Matematica), pending the establishment of an International Computation Centre on a

permanent basis. The Provisional Centre has been created for a period of two years but will automatically cease to exist when the inter-governmental Convention establishing an International Computation Centre comes into force.

44. The Provisional Centre commenced its activities in January 1958, in Rome. The main functions of the Centre are: (a) to ensure mutual assistance and international collaboration between existing bodies dealing with computation and information processing, in particular as regards scientific and technological studies; (b) to promote the exchange of information both on scientific matters and on the facilities existing in various countries; (c) to assist, on request, the countries which do not possess their own computation equipment, and this assistance may consist either in undertaking certain computation tasks with the help of existing services or in giving advice for the creation of national centres; (d) to help international organizations which require its assistance; (e) to promote the training of specialized staff; (f) to act as a link between the users and the designers of computation equipment.

C. World Meteorological Organization

45. The objectives of the World Meteorological Union (WMO), as stated in the World Meteorological Convention of 1947, are:

(a) To facilitate world-wide co-operation in the establishment of networks of stations for the making of meteorological observations or other geophysical observations related to meteorology and to promote the establishment and maintenance of meteorological centres charged with the provision of meteorological services;

(b) To promote the establishment and maintenance of systems for the rapid exchange of weather information;

(c) To promote standardization of meteorological observations and to ensure the uniform publication of observations and statistics;

(d) To further the application of meteorology to aviation, shipping, agriculture, and other human activities;

(e) To encourage research and training in meteorology and to assist in co-ordinating the international aspects of such research and training.

46. The Organization acts as a clearing-house for the exchange of information among its members, and for the promotion of agreements among its members regarding both the routine and exceptional transmission of meteorological data. It is not,

however, an operational organization. It operates neither weather stations nor communication facilities. Its recommendations and agreements are carried out only through the co-operation of the meteorological services of the member countries.

47. Since earth satellites represent a new observational tool of great potential value to meteorology, early in 1958 WMO began to consider its role in connexion with international co-operation and programmes in the peaceful uses of outer space.

48. The subject was placed on the agenda of the tenth session of the Executive Committee of WMO (29 April - 17 May 1958). The Committee decided (resolution 14 (EC-X)) that WMO should accept responsibility for meteorological questions related to artificial satellites in so far as they call for action or study by a specialized agency of the United Nations. The Committee further requested the President of its technical Commission for Aerology (CAE) to nominate a rapporteur to study the meteorological aspects of artificial satellites and to report to the eleventh session of the Executive Committee on any possible activities which might legitimately be undertaken by WMO in this field.

49. The report prepared by Dr. H. Wexler, was submitted in April 1959 to the Third Congress of WMO which (resolution T.9 (Cg-III)) laid down the following policy: the organization would encourage the development and use of artificial satellites as a means of providing valuable meteorological data, and collaborate as required with the United Nations, other specialized agencies and scientific organizations, in particular COSPAR, in artificial satellite programmes of interest to meteorologists or on which the advice of meteorologists would be useful.

50. The eleventh session of the Executive Committee, which took place immediately after the Third Congress, took note (resolution P.6 (EC-XI)) of the latter's policy and directives. It further arranged for an evaluation to be made of the above-mentioned report by the relevant technical commissions of WMO. The Executive Committee also set up a panel of experts, including representatives from its Commissions for Aerology (CAE) and Synoptic Meteorology (CSM), with the following terms of reference: (a) to keep a continuing review of the possible uses of artificial satellites for meteorological purposes; (b) to make suggestions as to how WMO can best assist in these activities; (c) to present a report to the next session of the Executive Committee.

51. The Organization is thus officially seized of the question of artificial satellites in so far as they have meteorological aspects and applications. It is

understood that the members of WMO are commonly agreed that while it is difficult to foresee all the aspects of the utilization of data from artificial satellites, satellites not only have opened the way to investigations of fundamental problems which are needed for the understanding of the general atmospheric circulation, the behaviour of rainfall patterns, and other phenomena of meteorological interest, but also offer an opportunity for the immediate operational use of observational data in forecasting throughout the world.

52. The Organization has directed its attention to both these aspects. The meteorological research interest in space is high because observations from satellites could well furnish completely new types of data having an ultimate significance which cannot be foreseen. The operational aspect is also of great importance as it offers a practical means for obtaining otherwise unknown synoptic information, for example concerning cloud cover over the uninhabited oceans. This is of particular significance in respect of the large oceanic areas of the Southern Hemisphere, but the resulting benefit would apply to the whole world. It would be possible, for instance, to conduct realistic studies of the exchange of energy between the polar regions - particularly the Antartic continent - and the equatorial belts. This exchange necessarily affects the general circulation, with consequential effects to the north no less than to the south of the Equator.

53. Bearing in mind that the meteorological components will probably be only a portion of the total instrumentation in any particular satellite, the meteorological utility could well be examined against the background of the over-all daily observational programme which has been organized by the members of WMO. As an example, mention can be made of the fact that several hundred radiosonde observations are made each day, at an annual cost running into millions of dollars. An effective meteorological design related to their research and synoptic use could thus strongly support a co-ordinated programme of research in other directions.

54. From a practical point of view, the operational use of satellite weather data would require co-ordinated facilities, (1) for interrogating the satellites and rapidly reducing the data to a form amenable for use in synoptic meteorology, and (2) for the systematic world-wide exchange of the data for immediate use.

55. The interrogating stations need not be designed solely for meteorological purposes. The existing space-vehicle tracking stations could be so utilized with a little co-ordination, but it would probably be necessary to institute an

additional number related to the extent of the over-all satellite programme which could be supported at any one time. Consideration could be given to the question as to whether it would not be a natural extension of WMO's present responsibilities for it to take part in the planning of the space vehicle tracking stations and in the design of the necessary computational practices and techniques for the reduction of the data to amenable forms for practical use. The existing WMO concern and responsibility in the design of codes for the world-wide exchange of data and the co-ordination of meteorological telecommunications could readily be extended to deal with satellite data.

D. International Telecommunication Union

56. The International Telecommunication Union (ITU) is the body responsible for the international co-ordination and rational use of all forms of telecommunications by landline, submarine cable or radio means. It is advised by two technical committees, the International Telegraph and Telephone Consultative Committee (CCIT) and the International Radio Consultative Committee (CCIR), which deal with line and radio problems respectively. In the field of radio communication, ITU drafts regulations which among other things define the conditions, procedure and standards for all applications of radio to the communication of intelligence in any form, including telegraphy, telephone, picture transmission, broadcasting television, radar, navigational aids, and scientific uses such as radio astronomy.

International control of radio transmission: the technical problem

57. Radio communication involves the radiation of electromagnetic waves, one of the important characteristics of which is their frequencies. Different bands of frequencies are allotted for different services within a spectrum which has rapidly become overcrowded as the applications of radio have increased, and this is in spite of the fact that for the present and in the foreseeable future the radio spectrum covers the range of 10 kilocycles per second to 3 million megacycles per second. It is thus necessary for all users to conform to very strict rules regarding the area within the band which they may use for their transmissions. Radio transmissions, and the codes and procedure used in connexion therewith, are subject to the control of national administrations, who, as members or associate members of ITU, are allotted precise radio frequencies and may operate transmissions only within their allotment. Consequently, the basic function of ITU is to

establish international regulations and codes of operation, and to act as the world agent for the equitable and effective distribution of radio frequencies to all users. These regulations and frequency allocations are subject to adjustments from time to time as may be required, owing to changing conditions or as a result of the improvement of radio techniques. Among the problems facing engineers are the vagaries in the propagation of radio waves around the earth, interference due to atmospheric disturbances, and variations in the troposphere (lower atmosphere) and ionosphere (upper atmosphere) through which the waves travel. The ionosphere, in particular, is subject to disturbance due to solar activity, with the consequent dislocation of terrestrial radio transmissions. It is obvious, therefore, that any launching of rockets or earth satellites which carry radio transmitters must be of concern to all persons connected with telecommunications, since these transmitters are potential sources of further interference with other terrestrial users of the radio spectrum. Over the past year many statements have been made, and there is considerable documentation about the pollution of the radio spectrum and the consequent difficulties for world communications.

58. As an indication of the future dangers that could be expected for the telecommunication services, it is easily possible for a satellite equipped with an effective radio transmitter to be supplied with batteries charged by solar radiation to continue in orbit for many decades. This could seriously interfere with communications that operate on the same frequency or adjacent frequencies to the satellite's transmission during its travel around the earth every hundred-odd minutes. But it is well to remember that it is explicit in the ITU regulations that no such avoidable interference may be caused.

59. According to the 1947 Convention drawn up at Atlantic City, ITU (a) acts as the general agent for the allocation of radio frequencies; (b) promotes the development of technical facilities by establishing standards and operating rules in order to improve telecommunication services; and (c) harmonizes the activities of nations for the attainment of these ends. To implement this work, the Convention set up an eleven-member International Frequency Registration Board (IFRB), whose duties are to record the frequencies allocated by members to users in accordance with the provisions in the Radio Regulations and to furnish advice regarding the maximum practicable number of radio channels in those portions of the spectrum where harmful interference may occur. To assist it in this aspect of its work, ITU has also the advice of CCIR. This is a scientific body which

meets every three years to consider various technical radio questions and to make recommendations for action either by its national members or by ITU. Further, CCIR has adopted the practice, in recent years, of calling upon URSI for its advice. This is a strictly non-political body which fosters international research in scientific radio, and brings a detached scientific approach to any radio problem including those that might in application have a political colouration. It is possible, or even likely, that COSPAR, if it continues in being, could similarly act in an advisory capacity in collaboration with URSI.

60. At the recent Los Angeles meeting of CCIR, a recommendation concerning the allocation of frequencies to transmitters on space vehicles was made; this will be presented during the Administrative Radio Conference of ITU, which will open on 17 August at Geneva. In its working paper presented to the Ad Hoc Committee, ITU indicates that the Conference agenda will also carry the item "Communications with outer space". Whether this will necessitate the amendment of the 1947 Convention remains to be seen. There appears to be no doubt, however, that efforts will be made for the reallocation of the radio spectrum to provide special bands for communications with and between locations in space.

The International Radio Consultative Committee and its recommendations

61. As already mentioned, the Committee meets in Plenary Assembly at intervals of about three years to consider questions that had been referred to one or more of fourteen study groups dealing with specific subjects. Recommendations adopted at its plenary meetings are submitted to ITU as a basis for action. Some technical and frequency problems are, however, settled by direct agreement at CCIR level. The very nature of radio communication makes mutual international agreement on frequency allocation essential. The Committee makes a study of the propagation of radio waves and reception characteristics in different parts of the world to enable it to recommend to ITU the best frequencies for the various services, from the point of view of reliability and freedom from interference. Atmospheric disturbances have been analysed and an atlas of thunderstorm activity prepared to facilitate the planning of world-wide radio communication systems.

62. In recent years frequencies had been assigned to radio astronomers, and their need for the exclusive use of certain bands in the radio spectrum has had to be

recognized. The Committee has recommended that ITU should afford complete protection to the frequencies used in radio astronomy: (a) molecular or atomic nuclear frequencies, particularly in the hydrogen line of the spectrum; (b) bands allocated for standard frequency and time-signal transmissions; and (c) seven other frequency bands that needed to be kept clear of man-made interference. The case of radio astronomy has thus established a precedent for the allocation and protection of frequency bands for a specific scientific purpose.

63. In the case of space research, COSPAR has already recommended that special frequencies should be assigned, and CCIR, at its Plenary Assembly held at Los Angeles in April 1959, considered the technical aspects of the matter. In a detailed technical report on "Factors Affecting the Selection of Frequencies for Telecommunication with and between Space Vehicles" (document 662), the relevant requirements are considered. In some cases, it is desired to use radio waves which will be deviated in the transmission through the ionosphere and troposphere, so that the characteristics of these regions can be studied by tracking signals received from satellites in known positions. In some other cases, it is desired to use frequencies for which the atmosphere is quite transparent, so that the waves pursue a straight line trajectory between the space vehicle and the receiver. In a third case, frequencies are required for intercommunication between the space vehicle and the receiver. Finally, frequencies are required for intercommunication between space vehicles under conditions that the corresponding waves may not be receivable at the earth's surface and so cause no interference with world communications using the same frequencies.

64. These brief comments serve to illustrate the fact that the allocation of frequencies for use in communications with and between space vehicles is a matter that requires some considerable study of the technical problems involved.

65. The Los Angeles Plenary Assembly of CCIR made recommendations and adopted resolutions on "Selection of Frequencies used in Telecommunication with and between Artificial Earth Satellites and other Space Vehicles" (document 531), "Influence of the Troposphere on Frequencies used for Telecommunication with and between Space Vehicles" (document 530), and "Effects of the Ionosphere on Radio Waves for Telecommunication with and between Space Vehicles beyond the Lower Atmosphere" (document 538).

66. In addition to making these recommendations and resolutions, CCIR set up a new Study Group "to study the technical questions regarding systems of telecommunications with and between locations in space". While the work of the study group will produce more specific recommendations as to what frequencies are appropriate for space communications, it seems likely that the progress of space science will necessitate ITU having to take early action in allotting frequencies for use in space vehicles, even if these are only available on a temporary basis.

E. International Civil Aviation Organization

67. The objects of the International Civil Aviation Organization (ICAO) are to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport so as to ensure the safe and orderly growth of international civil aviation throughout the world.

68. While ICAO has not so far carried out any specific activity directly related to the peaceful uses of outer space, a number of problems of outer space fall within the field of interest of the Organization.

69. The Convention on International Civil Aviation of 7 December 1944 recognizes the sovereignty of each State over the air space above its territory, but includes no definition of air space. Such a definition would determine the scope of application of that Convention as well as of ICAO's sphere of action. Furthermore, while the subject of the Convention is "aircraft", a definition of "aircraft" is not given therein. The Organization has adopted technical annexes to the Convention in which aircraft is defined as "any machine that can derive support in the atmosphere from the reactions of the air".

70. The launching of vehicles into outer space involves their passage through air space; such vehicles may subsequently re-enter air space. At the national level, the necessary co-operation between the responsible agencies has already been developed. At the international level, an equal degree of co-operation will be required in order to ensure the safety of air navigation during the time of launching or of re-entry of space craft through space used by aircraft.

71. One of the objects of ICAO is to "meet the needs of the peoples of the world for safe, regular, efficient and economical air transport". Technical developments may advance to the point where space vehicles will be used for transport of mail

and other goods, and even of persons. Evidently, ICAO would have an interest in any system regulating the two activities.

72. In February 1959, the Council of ICAO decided to bring to the attention of the Assembly of the Organization, due to meet on 16 June 1959, a suggestion made to the Council that a study be made of the legal status of outer space and the regulation of the use of space craft, particularly with reference to the traffic of civil aircraft in air space. However, since the question relating to outer space is under special consideration by the United Nations, the Council has pointed out that any action by ICAO on the subject should take into account the need for co-ordination with the deliberations of the United Nations.

F. International Atomic Energy Agency

73. No work is contemplated by the International Atomic Energy Agency (IAEA) in the field of outer space in the immediate future. However, IAEA has an interest in the nuclear technology of outer space and might advise on its health and safety aspects.

G. World Health Organization

74. The World Health Organization (WHO) is not now doing any work specific to outer space nor does it contemplate doing so in the immediate future. The Organization can, however, be most useful to any outer space programme in stimulating research, publishing medical findings and holding symposia and seminars pertinent to medical or health problems associated with space exploration and travel.

H. Inter-Governmental Maritime Consultative Organization

75. The Inter-Governmental Maritime Consultative Organization (IMCO) has at present no programmes in the field of outer space. However, in view of its over-all responsibilities for international shipping matters, particularly the problems of safety at sea, navigation and improved communications, it can be expected to become associated with outer space developments affecting these responsibilities.

PART II

(PARAGRAPH 1(b) OF GENERAL ASSEMBLY RESOLUTION 1348 (XIII))

I. INTRODUCTION

A. Mandate of the Committee

1. The task of the Ad Hoc Committee on the Peaceful Uses of Outer Space under paragraph 1(b) of General Assembly resolution 1348 (XIII) is to report on:

> "The area of international co-operation and programmes in the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices to the benefit of States irrespective of the state of their economic or scientific development, taking into account the following proposals, inter alia:
>
> "(i) Continuation on a permanent basis of the outer space research now being carried on within the framework of the International Geophysical Year;
>
> "(ii) Organization of the mutual exchange and dissemination of information on outer space research;
>
> "(iii) Co-ordination of national research programmes for the study of outer space, and the rendering of all possible assistance and help towards their realization."

2. In preparing this report, the Committee has reviewed the present position and trends in peaceful space activities from a scientific and technical point of view. Drawing on the experience of its members in international scientific co-ordination, it has then analysed the present methods and organs for co-operation in the use of outer space and considered areas of present and future need for co-operation.

3. The Committee completed its task by specifying areas in which co-operation might appropriately be undertaken under the auspices of the United Nations.

B. Brief history

4. Man's interest in space is age-old. Until the last decade, however, his inquiries into the properties and objects of outer space have been confined to observations and measurements made from the surface of the earth or near that

level. Mountain-top observatories, aircraft and balloons served in the past to sharpen the scientist's measurements, but it remained for the high altitude rocket to open the domains of outer space to direct observation without the obscuring and distorting effect of the earth's atmosphere.

5. Rocket exploration of the upper atmosphere began in 1945. Since then both the development of rocket vehicles and of the techniques for making measurements by rocket-borne instruments have advanced rapidly. The year 1957 saw the advent of man-made satellites circulating around the earth in the adjoining space, and in 1959 vehicles were launched which passed out of the area predominately controlled by the earth's gravitation to become new planets circulating around the sun. It is now possible to explore the earth's atmosphere with many kinds of instruments to all heights, to place instrumented satellites above the atmosphere, and to probe the depths of space between the planets with automatically operating scientific equipment. Numerous facilities with varying capacities for the launching of scientific research rockets exist around the world, and many countries are expanding their activities in rocket research.

6. Looking into the future, and bearing in mind the rapid development during the past decade, it seems possible now to make reasonably realistic forecasts about expected developments valid for the next two to four years. Admittedly, present views into the future must be subject to continuous review and extension as new lines of thought are developed on the basis of technological achievements.

C. Problems that face us

7. In space activities, scientific and technological, there has been a great surge forward which opens new perspectives for human progress. Even more than in astronomy, they inherently ignore national boundaries. Space activities must to a large extent be an effort of Planet Earth as a whole. Along with the opportunities in prospect for all peoples in the space age, there are problems which face us in arranging for these advances in science and technology on a global scale.

8. Means must be found to utilize scientific and technical talent wherever it may exist, either in connexion with space experiments and undertakings themselves or in the invaluable supporting research and activities which must go along with

them. Means must be found for co-ordination and facilitation of the activities of the scientific community. A wide-spread problem is the encouragement and support of space activities nationally commensurate with the obvious international and popular interest. For some aspects the question of international financial support becomes important and would be on an unusually high scale compared with most previous international undertakings in science and technology.

9. Coming sooner than many realize are problems connected with effectively taking advantage of the practical applications of space science, some of which, like weather, are already over the horizon while others will surely rise in the near future.

10. The Committee recognizes that the great forward surge of space activities may also tend to widen the gap between the technologically advanced nations actively launching vehicles into space and other nations watching and wishing to take part in space activities, but feeling unable to do so. The problem is to make available and to exploit the possibilities that exist for participation by nations at all levels of development, from supporting research or operation of tracking stations to launching small vehicles or joining with others in more advanced undertakings. A related problem lies in arranging the sharing of basic scientific information and topical data so that wide-spread participation is possible.

11. The Committee feels strongly that the conduct of space activities must be effectively open and orderly. It is therefore important to find means for having peaceful space activities clearly announced right from the earliest stages and to make such activities known both to scientific specialists and to the world at large in an efficient manner. A determined attack on these problems is urgent, because the development of space activities is advancing at a staggering rate.

12. Finally, there is the over-all question of whether man's advancement in outer space will redound to his benefit. Here man's intent is of overriding importance, a point which was recognized during discussions at the last session of the General Assembly, when the resolution which established the Committee was adopted. The Committee has borne in mind throughout the fact that other organs within the United Nations have been given the important tasks of lessening international friction, encouraging mutual trust and confidence and facilitating progress on disarmament.

D. References to conclusions

13. The following sections of this report contain numerous specific conclusions. The Committee considered the desirability of restating these conclusions explicitly in a final section, but found that to do so would require considerable repetition of the text. The following section index calls attention to these conclusions:

14. Attention is also drawn to the general conclusions given at the end of the report.

II. SPACE ACTIVITIES

15. At the outset it is desirable to emphasize that scientific work in outer space embraces many disciplines involving both pure research and applied research.

In the area of pure science, the primary objective is the advancement of knowledge of the environment in which the earth moves, and later the extension of this knowledge to other parts of the solar system, and even further afield. In the applied and more technological area there are two phases:

(a) The development of space vehicles of a great variety of sizes and uses;

(b) The use of these vehicles to advance applied science in such fields as meteorology and communication.

16. The development of vehicles which make possible the scientific study of outer space has, to a large extent, been the outcome of military objectives and therefore problems of national security have prohibited the free exchange of information. Nevertheless, the technology of these vehicles has developed along parallel lines in several countries and it may be stated that the problems are now more those of engineering than of science. In view of this, the Technical Committee has not considered it necessary to deliberate on the vehicles used for the exploration of outer space, but has started with the premise that these are available even though the larger vehicles are at present only available to countries whose industrial, technological and, especially, financial resources make them possible.

17. Although great resources are required to construct a space vehicle of extreme range, this does not in any way mean that scientific activities in space are limited only to large countries. Knowledge of the physical state of the upper atmosphere (the exact limits of which cannot be defined) at levels inaccessible to aircraft and balloons is far from satisfactory. Between the range attainable by aircraft and balloons and the lowest practicable satellite level, comparatively inexpensive rockets can be used for the conduct of scientific experiments and many countries should be able to participate in the experiments. The feasibility of such experiments has been well demonstrated by the excellent work carried out by Australian, Canadian, French, Japanese, Soviet, United Kingdom and United States scientists who have made valuable contributions quite apart from the more spectacular results of satellites and space probes.

A. Scientific investigations

18. The kinds of measurements made in space science programmes are mostly similar to, or developments of, those made from balloons or sounding rockets in the past

several years. In this era of advancing space technology, more complex measurements in the lower atmosphere can be made. The regions accessible to measurement are now being extended to the earth's outer atmosphere, into interplanetary space, to the moon and planets and the sun. The simple experiments of today will soon develop into work with complex satellite or space observatories. Some of the aims of space investigations are to increase our knowledge by direct or improved observation of the following:

(a) The atmospheres of the earth, sun and planets, as well as possible vestiges of an atmosphere on the moon, including the electrically conducting regions or ionospheres in these atmospheres;

(b) Electric, magnetic, and gravitational forces throughout space in the solar system, whose strength and properties have hitherto only been inferred by very indirect reasoning;

(c) Diluted gas and scattered dust particles in space between the planets and within comets;

(d) Electrified particles, in some cases emanating from the sun, and always influenced by electric and magnetic forces within the solar system; such particles include those producing the polar auroras, those stored in the radiation belts in the vicinity of the earth, and the very energetic cosmic rays;

(e) The details of the external form and the internal composition of the earth, planets, and moon;

(f) Conceivable living organisms outside the earth, either on the surfaces of other planets or elsewhere;

(g) Stellar and galactic objects and phenomena.

Special problems such as the verification of certain conclusions from Einstein's general theory of relativity, are also among the objectives of space experiments.

19. These objectives are attainable by series of individual experiments, each with its special instruments, especially designed and tested to withstand the rigours of launching and of the space environment. A whole new technology is involved in the systems for taking the results of the experiments and transmitting them back to earth.

20. The first use of earth satellites and space probes was made under the auspices of the International Geophysical Year (IGY). The Year enterprise was

sponsored by the International Council of Scientific Unions (ICSU), a non-governmental body, and was carried out through the co-operation of national scientific groups in some sixty-six countries, each of which decided on its scientific programme and arranged for its support. Many countries had programmes in the IGY category "Rockets and Satellites". As a means of continuing this kind of voluntary international co-ordination and co-operation, ICSU has established the Committee on Space Research (COSPAR).

21. It is too early in the space age to envisage all, or even the ultimately most important applications of space research; however, experience from other areas of scientific inquiry started or spurred by some marked scientific or technological advance gives considerable assurance that the findings of space science will have a strong influence on the future of mankind.

B. Applications furthering human welfare

22. As a result of these scientific investigations, it can be expected that there will be many developments leading to practical applications which in turn will add materially to the comfort and well-being of the world at large. A few of the possible applications of space technology are now coming into focus and are at present in the earliest stages of development. How and when these applications will mature will depend on many factors which cannot now be predicted. Some of the applications which are now foreseen are: the collection of data, particularly for immediate meteorological purposes; the improvement of long distance radio communication; a means of improving man's view of the size and shape of the earth and of the distribution of land masses and water; and an all-weather global navigational system.

23. These and other applications of satellites that develop as a result of advancing technology will not become feasible immediately, but must necessarily depend upon an orderly sequence of technological developments. It must be realized, however, that the time when these applications will become available depends on many other factors over which the scientist can exercise no control.

C. Improvement of weather forecasting

24. Historically, meteorologists had to rely first on observations that could be made on the ground. Over the years, a meteorological network has been established using ground stations and many types of vehicles ranging from ships and aircraft to balloons. Despite the geographical extension of this network into many parts of the world, it is still inadequate. The earth is covered by such extensive regions of water, ice, and desert that only about one fifth of the atmosphere is under regular observation, and wide areas of storms or other extremes of weather remain inadequately observed until they arrive at populated areas. Vertically, balloons rarely reach higher than 30 kilometres, and they ascend slowly, drifting away from the observation station to inconvenient distances.

25. Meteorological rockets ascending vertically can be used for routine measurement of pressures, temperatures and humidity. This can be done inexpensively up to heights of 60 kilometres. Rockets can also be made to eject small bits of metal foil or other good targets for radar and in this way permit measurement of wind direction and speed up to as much as 45 kilometres height. Rockets carrying cameras can be used to photograph cloud areas from above, and thus aid in the detection of squalls, hurricanes, typhoons and other large cloud formations.

26. In a different way, satellites circulating in closed orbits around the earth will soon provide meteorologists with another tool for surveying the large, inadequately observed parts of the globe. Thus man will obtain a downward look at clouds, and with a proper distribution of such satellites, it should be possible to keep track of each major storm, to note the birth of new storms and rain areas, and the death of old ones.

27. Some of the earth satellite techniques required for this extension of the capabilities of meteorological systems may be available within a few years; others may require a development period of over a decade. An ultimate system to accomplish regular collection of meteorological data on a global basis might make use of perhaps six to eight satellites in 800 to 1,600 kilometre altitude polar orbits as well as several satellites in 35,000 kilometre altitude equatorial orbits.

28. Future progress in weather forecasting over longer periods than a few days depends on the delineation of large-scale features of weather over the globe, as

distinct from local studies in limited areas. Another significant application is the comparison between the heat received from the sun and that reflected or radiated from the earth into space. Such satellite measurements may assist in anticipating climatic changes and may possibly contribute to the development of new systems of long-range weather forecasting.

29. The use of meteorological satellite systems would not, of course, replace other observation techniques. These, with sounding rockets important among them, would continue to be needed to provide detailed knowledge of the structure of the atmosphere at lower altitudes. The total quantity of data collected would be tremendous and since the data would have to be used within a few hours, there would be a requirement for new techniques for interpretation and utilization. In this connexion it may be appropriate to suggest that the International Computation Centre at Rome, established with the assistance of UNESCO, is concerned with precisely such problems.

30. A foreseeable benefit would be to extend weather forecasting capabilities from the present limit of days to periods of several weeks and beyond. No less important than the obvious practical assistance to weather forecasting will be the contribution to basic knowledge of the workings of the atmosphere which may assist in anticipating climatic changes. Ultimately these advances should afford direct benefits to agriculture, industry and transportation.

D. Improvement of radio communications

31. Currently available means of world-wide communications suffer from severe limitations of capacity. For example, the present transatlantic cables are expected to be saturated by 1962. Owing to the anticipated increase in messages during the coming decade, a new cable with several times the capacity of the present ones will be saturated by the time it is available.

32. Apart from enclosed cables, world-wide communications depend on the presence of reflecting regions in the high atmosphere which permit radio waves to be sent from one part of the world to another, despite the obstacle presented by the curvature of the earth. Nature has provided such reflecting regions in the high levels of the atmosphere, from 70 kilometres upwards where free electric charges are created when the sun shines on the air. However, these natural reflecting

layers are only useful on certain radio wave-lengths and are ineffective on others. Since they are often disturbed by electromagnetic processes on the sun and by polar auroras, their properties are erratic at certain times and places which can only be anticipated in part.

33. In view of these circumstances, it has become desirable to search for new means of economical world communications; a promising approach to a truly world-wide system is the use of earth satellites as passive reflectors or active repeaters.

34. In the case of the passive reflector, an antenna using much shorter waves will beam a powerful signal at the satellite which will reflect it in such a manner that it may be received by suitable equipment anywhere within reach, or will reflect the signal in specific directions. Such a satellite might be used simultaneously by many, subject only to allocation of non-interfering frequencies. An operational system might involve some twenty-five satellites together with extensive ground equipment.

35. The technique of using active repeaters in satellites will involve directing a signal to a satellite, which in turn will rebroadcast it to the ground. Rebroadcasting may be accomplished instantaneously or with suitable delay until the satellite has moved into a good position relative to the intended receiver. Three such satellites spaced 120 degrees apart in 35,000 kilometre altitude orbits at the equator might comprise a useful system.

36. Each of the two techniques appears to have advantages and disadvantages. Passive reflector systems involve simple satellites but appear to require relatively large numbers and involve heavy requirements for ground transmitting and receiving equipment. Active repeater systems appear to require fewer satellites and reduced ground equipment; however, they would be susceptible to defective operation, have a limited frequency range, and require a continuing power supply on board.

37. Communications satellites are currently in a very early stage of development. Their technical aspects remain to be explored as does the full extent of their economic and other implications. However, the substantial increase in the amount of information that may be transmitted internationally in a given interval

of time may ultimately have a major impact on the relations of countries throughout the world.

38. It should be noted that preliminary experiments conducted at moderate cost with vertically ascending rockets give ample scope for important contributions from scientists in many countries to this technical problem.

E. Geodetic and mapping satellites

39. Geodetic and mapping satellites offer the means of improving man's view of the size and shape of the earth and the distribution of land masses and water. Optical observation of geodetic satellites has the potentiality of yielding the observer's location to less than 30 metres while mapping satellites provide a means for charting the little explored regions of the world. Improved data on geographical details of the earth may be of economic as well as scientific significance.

F. Navigation satellite

40. The navigation satellite may provide the basis for an all-weather long-range navigation system for surface vehicles and aircraft. With the use of suitable ranges of frequencies for transmission, it would be possible to establish positions with great precision irrespective of the prevailing weather. At the present time, there is no such world-wide all-weather system of navigation.

G. Manned space flight and exploration

41. Initial interest in man's role in space has been concerned with the utilization of his unique characteristics which allow him to absorb a wide variety of observations, to remember and to make decisions in a way that cannot be duplicated by machines. Such human qualities as persistance, resourcefulness and the relative reliability of the complex human system further indicate the need for man's inclusion in the development of space flight and exploration.

42. Although unmanned vehicles will have preceded man in the exploration of space, perhaps effecting landings on the moon, penetrating interplanetary space, and at least approaching the planets, the addition of man to these efforts will

constitute a dramatic innovation, one which is only in part "scientific" in purpose and only in a special sense a "practical" application of space vehicles. The motivation of manned space exploration goes deeper than any scientific and other practical results. Apparent throughout man's history is a basic urge to discover and to explore, to go where no man has gone before, to go everywhere man has the means of going. As it becomes possible for man to explore outer space, he can confidently be expected to do so.

43. The first demonstrations of manned space flight can be expected in the near future, probably in the form of experiments with rockets followed by relatively simple manned orbital vehicles. Looking well beyond such initial efforts, it is possible to foresee the initiation of true manned exploration of space, that is the use of space vehicles to enable man to reach, investigate and return from the moon, interplanetary space, and ultimately at least the near planets. There does not appear to be any foreseeable prospect of manned exploration of interstellar space.

44. Although no insuperable problems have yet been identified, the scientific and technical problems of true manned space exploration are substantial, and the period required for full perfection of the necessary vehicles, equipment instrumentation and techniques will be measured in terms of decades rather than years.

III. TOOLS FOR SPACE ACTIVITIES

45. The development of vehicles for scientific activities in outer space is the key to executing a successful space programme. Over the centuries, man has accumulated a good deal of knowledge about his planet, the solar system and the universe, but any real penetration of space must still await the development of adequate vehicles. In terms of the mission to be accomplished by these vehicles, they can be classified as follows: (a) sounding rockets; (b) earth satellites; and (c) deep space probes.

A. Sounding rockets

46. Rocket exploration of the atmosphere began in 1945. Since then both the development of rocket vehicles and of the techniques for making measurements by rocket-borne instruments has advanced rapidly.

47. The phrase "sounding rockets" designates a rocket research vehicle that is used to sound the upper atmosphere, in much the same sense that the mariner sounds the ocean depths or the meteorologist uses sounding balloons for observations in the lower atmosphere. There exists a wide variety of sounding rockets; some can reach heights of only tens of kilometres, while others reach to hundreds of even thousands of kilometres. In an effort to distinguish between sounding rockets and the deep space probe to be discussed below, an arbitrary definition is adopted as follows: a sounding rocket is a vehicle launched vertically or nearly vertically that reaches an altitude of no more than one earth's radius, or approximately 6,000 kilometres.

48. This definition is somewhat arbitrary, though not completely so. There are advantages to this definition in that vehicles to attain heights greater than about one earth's radius are substantially more expensive than those designed for lesser heights. Thus, one may anticipate the participation of many countries in sounding rocket programmes, whereas participation in the launching of deep space probes will probably be limited for economic reasons. Similarly, a sounding rocket operation can generally be carried out entirely within the domains of a single country.

49. With present technology, the state of the upper atmosphere can be studied by means less expensive than rockets, up to heights of about 30 kilometres. Relatively inexpensive sounding rocket experiments may start from this level and extend upwards. Satellites, as has been noted, cannot cover the intermediate levels between the 30 kilometres mentioned previously and the lowest practical satellite orbits of about 200 kilometres, yet knowledge of the physical state of the atmosphere at these levels is far from satisfactory.

50. Whereas we have much to learn about the methods and techniques of fully exploiting satellite and space probes, sounding rocket technology is now at the stage of becoming fully developed.

B. Earth satellites

51. An earth satellite is simply a man-made moon revolving about the earth. The work of the past year or two has already shown the possibilities of artificial earth satellites as a new technique for exploring the physical characteristics of the earth's atmosphere and the space beyond.

52. When launched in a satisfactory manner as to speed and direction, these satellites travel in elliptical orbits around the earth at heights which may range from a few hundred to many thousands of kilometres. Such a satellite forms a vehicle which may house a number of scientific instruments, and can carry out a number of functions simultaneously.

53. The data associated with the experiments can be obtained from a satellite in three ways: (a) by transmission directly to the earth by radio communication; (b) through storage in a suitable recorder which can be interrogated by radio command when the satellite is in a suitable position relative to a receiving station; or (c) eventually, through physical recovery of records from satellites that are returned to the earth.

54. In the case of (a) it is necessary to have suitable receiving stations deployed over the earth to collect the information at various points as the satellite travels round its trajectory. In the case of (b), although the stored information can be extracted when required, it is still necessary to have a network of tracking stations over the earth, in order to establish the positions of the satellite at the times the various scientific observations were made.

55. The orientation of the orbit of the satellite is predetermined by the launching conditions. When set at an appropriate angle to the meridian, this trajectory may either cover the entire surface of the earth as it rotates as it would in passing over the poles, or it may be confined to a relatively small zone about the equator. For different investigations, different orbital trajectories may be required and careful planning on an international scale is required to make the best use of this expensive type of technique.

56. Among the space vehicle operational techniques yet to be perfected are those related to the re-entry and recovery of vehicles. At this time, not all the problems associated with this type of operation can be fully evaluated, but because of the nature of the problem, it may be desirable to consider ways and means of minimizing the possibility of accidents.

C. Space probes

57. A space probe is defined as an exploratory vehicle, not an earth satellite, that goes into space beyond one earth's radius from the surface of the earth. Such vehicles can be instrumented for numerous important scientific investigations.

58. By launching a payload at a sufficiently great speed, a rocket can be used to project scientific instruments into interplanetary space. If the aim of such a space probe is simply to make measurements deep in space, far from earth without any particular reference to any celestial body such as a moon or planet, then it suffices to project the object at a sufficiently great speed in a general outward direction. On such a mission, control mechanisms can be kept at a minimum. On the other hand if, for example, it is desired to project the object close to the moon or close to Venus, then exacting control and timing requirements must be met.

D. Network of observing stations

59. Ground observing stations are essential to the successful conduct of any space activity involving satellites or space probes. The primary functions of such stations are: (a) tracking the space vehicle by radio, radar and optical methods, and (b) receiving and recording the radio signals transmitted from the vehicle. These signals contain in coded form the observational measurements made in the vehicle: this is called telemetry. Some stations may be used to give instructions by radio to the vehicle. In general, a world-wide network of stations is needed, although in some cases only a small number may be required. For sounding rocket experiments, for instance, usually only a single station or close-spaced group of stations is needed.

60. Tracking is done by radio techniques for satellites while they transmit. Optical and radar techniques can be employed throughout the life of a satellite. High accuracy of position and time are essential to allow the orbit to be determined well enough to predict future positions for many days in advance. Prompt reporting of tracking observations to computation centres, rapid calculations, and prompt dissemination of prediction information are requirements for an effective tracking network. Customarily, all available observations are used for calculations intended to improve subsequent predictions, while only the most precise tracking observations are used for determination of the definitive orbit needed in interpreting the scientific experiments which may be carried on the satellite.

61. Radio is almost the only way to track space probes. When these are at large distances from the earth, the signals are inevitably very weak and require the use of large radio telescopes such as those used in radio-astronomy for detection. However, few stations are needed in the tracking network for such experiments because at great distances the vehicle is observable from about half of the earth.

62. Telemetering signals are commonly recorded at the same stations which do radio tracking. For space probes this is almost essential because of the extreme sensitivity of receiving equipment needed for both purposes. However, for satellite experiments, telemetry may be recorded easily with radio receivers without the complicated arrangements for measuring the angular position of the radio transmitter. For many experiments, more telemetry stations are needed than tracking stations.

63. The operation of tracking and telemetry equipment in this network of ground stations has been an important way in which many countries have participated in space science beginning with the International Geophysical Year. Some countries have also used tracking-type observations of satellite radio transmissions to make significant findings about the earth's ionosphere. No single country extends over a sufficient range of latitude and longitude to be able to track earth satellites adequately from its own stations. Earth satellite experiments have been wholly dependent upon international co-operation. This has been accomplished within the IGY-type framework. Necessary improvements and extensions can be handled within the existing framework.

64. Radio transmissions from satellites and space probes are the only practical way for the scientist to get information on experiments in progress; they also are the only practical way to track the course of the vehicle, at least until the orbit or trajectory is well determined. Thus the availability of radio frequencies which will not be interfered with by terrestrial radio transmissions is a matter of life and death to the progress of space activities. This is one of the important matters requiring international action in the field of space. The prospective number of satellites and space probes to be launched in the next few years is in the hundreds.

IV. SUPPORTING RESEARCH

65. Many research activities not directly connected with actual flights of sounding rockets, satellites and space probes are essential to the progress of space science and technology. A large portion of scientific research in the field of extra-terrestrial space is done on the ground either at sea level or in high mountains or with the help of balloons up to the altitude of about thirty kilometres. In addition, there are important studies to be done in the laboratory before or after the experiments using space vehicles; such studies may be theoretical or experimental. Contributions in these areas of research have been made in a large number of countries in recent years. In the future, the prospering of space science will continue to depend heavily on work done in countries and by groups of scientists that may not require direct access to space vehicles.

66. Examples of supporting research areas and topics would include the following:

A. Research which may lead to new or improved equipment to be flown in space vehicles

This includes:

(a) Instrument components: power supplies, telemetres, light sources, image intensifiers, photon counters, photomultipliers, micro-electronics;

(b) Instruments: magnetometres, spectrometres, pressure gauges, ion probes;

(c) Materials: photosensitive, heat resistant;

(d) Environmental tests: acceleration effects, radiation effects, vibrational effects;

(e) Biological: life support systems, foods, removal of gases and poisons;

(f) Psychological: confinement, effects of sensory deprivation.

B. Research which may lead to more nearly optimum trajectories or knowledge of orbits

This includes:

(a) Aerodynamics;

(b) Propulsion: methods, including plasma, ions and photons;

(c) Guidance techniques and systems;

(d) Tracking methods;

(e) Computational methods for obtaining orbits and trajectories.

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C. Ground-based physical observation and research

This includes:

(a) Planetary astronomy: physical observations of planets and planetary atmospheres by optical and radio techniques;

(b) Solar activity: optical flares, radio outbursts, corona, direct and indirect evidence of particle ejections;

(c) Comets: photometry and spectroscopy;

(d) Cosmic rays: study of primary or secondary cosmic ray particles accessible to ground or mountain-top stations and balloons;

(e) Meteors: number, size, orbits by optical and radio techniques;

(f) Meteorites: composition, structure;

(g) Ionospheric studies: vertical soundings, scattering, whistlers;

(h) Geomagnetism: survey of field at surface, variations, disturbances.

D. Theoretical research and mathematical methods

This includes:

(a) Magnetohydrodynamics;

(b) Cosmology;

(c) Astrophysics;

(d) Celestial mechanics;

(e) Information theory, including data processing and reduction.

67. Exchange of information is needed in all phases of space research. However, in the areas which are described here, this exchange is particularly valuable because scientific groups in so many countries participate in theoretical, laboratory and ground-based research. Modern techniques could be used to solve documentation and language problems involved in such exchange, which could also be encouraged by symposia, conferences and exchanges of research staff. Mechanisms for some of this exchange of information are being carried over from the period of the International Geophysical Year.

V. INTERNATIONAL CO-OPERATION IN THE CONDUCT OF SPACE ACTIVITIES

68. There is a wide area of activities in which international co-operation is desirable, and in some cases required, in order to realize to the fullest the potential benefits of space activities. In some cases, there is simply a

requirement for mutual agreements on how to approach specific problems. Once such agreements have been arrived at for the open and orderly conduct of space activities, they can form the basis of an international routine. In other cases, there is need for active co-operative endeavours in which groups of nations assist each other in carrying out various phases of space activities. The following list is illustrative of these kinds of international co-operation:

A. International agreements

Use of radio frequencies

69. Accomplishment of most uses of space vehicles will depend heavily upon the adequate availability of communications channels. Allocation of frequencies specifically for use by space vehicles and in space activities will be necessary to assure that channels will be available as needed. There already exists in ITU and its advisory bodies the means for handling this problem. The Committee agrees that there is an urgent need for international co-ordination of radio frequencies for use in association with space vehicles for tracking, telemetry and research purposes. Interference by space vehicles might seriously affect radio services on the earth. Similarly, radio interference from terrestrial sources could cripple the conduct of space programmes. The Committee strongly urges that ITU and the States members of the 1959 Administrative Radio Conference of ITU allocate adequate frequencies for space programmes, with adequate bandwidths for the foreseeable needs of space programmes in the next three years.

Registration of orbital elements

70. Precise orbital elements are determined by launching countries from data acquired during the launching and initial orbital phases. In addition to scientific and technical usefulness, information concerning precise orbital elements might assist in identifying individual satellites. The problem of identification will become increasingly difficult as satellite traffic overloads the ground facilities. It will, therefore, probably be useful for orbital elements to be registered at a central point.

Continuing radio transmission

71. Solar-powered transmitters as well as possible future types of equipment may continue to transmit long after the experimental or other purpose of a satellite has been fulfilled. Such continued transmission can result in interference with transmission from space vehicles still performing a useful purpose. Therefore, it will be necessary to provide for termination of transmission at the end of the satellite's useful life.

Removal of spent satellites

72. The continued orbiting of satellites beyond the period of their useful operational life imposes the necessity of continuing their observation and registration. The foreseeable increase in this space "traffic" problem is formidable. Destruction or recovery of such spent satellites, if possible, might be desirable to limit the "traffic" problem to those satellites actually performing useful functions. This is feasible in larger satellites which are capable of carrying the necessary braking rockets required to cause the satellites to descend at the end of their useful lives. The "traffic" problem is, of course, not in space itself but in the capacity of ground tracking networks.

Re-entry and recovery of space vehicles

73. Among the space vehicle operational techniques yet to be perfected are those related to the planned re-entry and recovery of space vehicles. International co-operation may greatly aid the successful accomplishment of such operations while minimizing the possibility of accident. International arrangements will probably be especially important in the case of re-entry of manned vehicles.

Return of equipment

74. Where space vehicles re-enter the earth's atmosphere either through design or misadventure and any equipment or instrumentation is recovered by countries other than the launching country, arrangements are needed for restoring such instrumentation and equipment to the launching country.

Identification of origin

75. Provision can be made in all space vehicles for identification of the launching country. Such identification would be useful where equipment is recovered from space vehicles which have re-entered the earth's atmosphere or where a question of liability arises in connexion with possible damage caused upon re-entry.

Contamination

76. Scientific studies indicate that certain activities related to lunar and planetary impacts might result in biological, chemical, and radiation contamination jeopardizing subsequent physical and chemical studies and endangering possible living organisms. Release of chemical markers, radio-activity resulting from nuclear explosions, generation of gases in connexion with "soft" landings and the spreading of terrestrial micro-organisms carried within space vehicles represent possible sources of contamination to the moon and planets. The re-entry of space vehicles which have effected landings on the moon and planets might contaminate the earth on their return. It will probably be desirable to continue such studies of this problem as are already under way, for example, in COSPAR, with a view to arriving at appropriate agreements to minimize the adverse effects of possible biological, radiological, and chemical contamination.

B. International co-operation in joint projects

Simultaneous sounding rocket launchings

77. In the use of sounding rockets to investigate the upper atmosphere and to conduct rocket astronomy experiments, there are several fields of investigation which would be promoted more effectively if simultaneous launchings were made in many countries, as happened during the International Rocket Week in 1958 during the International Geophysical Year, and as is planned for the autumn of 1959 by COSPAR. Organizations such as the International Council of Scientific Unions and the International Astronautical Federation are available to plan the scientific and technological programmes respectively, but some encouragement by the United Nations may be worth-while.

International use of launching ranges

78. Thought should be given to means of making available launching ranges for vertical sounding rockets on an international scale for the conduct of experiments for scientific purposes. This has already been done in several cases by mutual agreement between nations or research institutions. This procedure is suitable at the present stage and will continue to be valuable during coming years.

79. In the more distant future, however, these thoughts might be elaborated towards considering the creation of an international rocket range. This step is much more ambitious than earlier arrangements, but its impact on truly international space research would be substantial. Much advice on the selection of programmes for international launching of vertical sounding rockets can be given through the organizations associated with the international scientific unions; possibilities also exist in the United Nations family for the exchange of personnel and for negotiations relating to agreement between Governments on scientific matters. But undoubtedly government negotiation initiated, for instance, through the United Nations, would be a necessary step to take before it would be possible to establish one or more international ranges for sounding rocket research.

Instrumentation of satellites and deep space probes

80. In some cases it may be desirable to arrange international co-operative projects to provide instruments and scientific payloads in space vehicles. There are several ways in which this may be done.

81. First, one or more scientists from various countries may be invited to become part of the team that is preparing the payload for launching into space. These scientists would work on their part of the instrument equipment in appropriate laboratories in the launching nations, participating as required in all phases of the work. This method seems quite workable and can confidently be expected to be effective.

82. Secondly, a scientist in the launching nation can be designated to prepare an experiment devised by a scientist of another country. He would then work in close co-operation with the originator, and represent him as necessary during all phases of the project. This method, too, is workable and can be effective.

83. Thirdly, one might envisage a scientist in one country preparing an experiment, sending the instrumentation as a box, or a group of boxes, to the launching nation for installation in the payload of the space vehicle. From experience, it can be said that this method will succeed only in exceptional cases, and should not be encouraged during the foreseeable future to the detriment of other approaches.

84. It appears that a strong element in the preparation of such joint instrumentation of space vehicles is the direct negotiation between the responsible scientific administrations. Similar conditions apply to the ground network of observatories at which the measurements must be made by scientists who may be trusted to organize their own co-operation in the most efficient manner.

85. It is worth noting that the international scientific organizations, such as the international scientific unions or UNESCO, can contribute substantially to the organization and planning of such forms of co-operation. In this field, however, it may well prove advantageous to have the supporting authority and goodwill of the United Nations, particularly to assist in the resolving of international problems confronting the scientists.

Tracking and telemetering

86. As discussed in paragraphs 59 to 64, the tracking of a space vehicle and the reception of telemetred signals from it are an essential part of obtaining the scientific or technical data for which the space vehicle is launched. In many cases it will be desirable to have several nations co-operate in the tracking of a space vehicle. Particularly in the case of earth satellites it may be desirable to continue such co-operative tracking for long periods of the satellite's operating life. In the case of space probes, on the other hand, co-operative tracking may well be required only during the first one or two days of the flight, after which only periodic tracking will be required which can probably be handled by the launching nation with its own facilities and tracking stations.

87. With regard to the telemetering of scientific information from space vehicles, similar remarks apply. It will be usual for the telemetering system to be an integral part of the tracking system. It will frequently be desirable to take continuous records for periods of from hours to days. In such cases, international co-operative reception and recording of the signals will be needed.

Data processing

88. The processing of tracking and telemetering data to useful form can be a formidable task, particularly in the case of earth satellites from which tremendous amounts of data may be received. It may be desirable to organize an international co-operative programme for such data processing.

Interpretation of data

89. The theoretical analysis and interpretation of experimental data from space vehicles comprise an area in which international co-operation is highly desirable. The most effective use can be made of experimental results by the participation of scientists throughout the world in interpreting those results and applying them to a further understanding of the universe and to the development of practical applications.

International exchange of data

90. Strong international support of existing organizations in the collection, cataloguing and dissemination of data and results obtained from space activities, including supporting research, is necessary if the world is to benefit fully from and to contribute to the advancement of the space era. Such support includes not only the financial assistance and management provided by the nations operating the already existing world data centres, but also an extension of the number and scope of such centres in view of the bigger role assigned to them by the channeling of data and results from all branches of space research and activities.

91. It appears also that some centralized advice and co-ordination in this area will be required, and this might well be continued within the UNESCO-ICSU framework.

Education

92. There will be a continuing need to inform not only the scientific and engineering communities, but also Governments and the public about space activities. UNESCO has had much experience in the preparation and dissemination of texts, manuals, lectures, television programmes, etc., and might be a suitable organization to assume the responsibility for this in the areas of space activities.

Meteorological satellites

93. It is to be foreseen that a meteorological satellite system of world-wide usefulness will be in operation some years from now. Some international arrangement will be necessary to insure maximum effectiveness of this system in benefiting commerce, industry, agriculture, etc. WMO is an appropriate organization to undertake such co-ordination, and in fact has already begun to consider this question.

Communications satellites

94. In the foreseeable future a system of communications satellites may be be placed in operation. As in the case of a meteorological system, the communications system will require international co-operation for maximum effectiveness. Problems of frequency allocations, the handling of message traffic, etc., will have to be solved. It would be well for ITU to begin a study of these problems at once.

International launchings

95. Launchings of satellites and space probes by an international team would be an extremely complex and organizationally difficult operation, which probably should not be attempted in the immediate future. On the other hand, it may be desirable on occasion for a single nation to undertake to launch a scientific satellite or space probe under the auspices of ICSU or the United Nations. In such an international project the scientific payload would be instrumented as a co-operative endeavour by some group of nations. In this manner scientists who would not otherwise have the opportunity of performing experiments in space vehicles may be brought more deeply into space research and engineering.

Advice on space activities

96. Much advice on an international scale on the selection of programmes, on the types of data that should be interchanged and placed in the world data centres, can be given through the organizations associated with the international scientific unions. Possibilities also exist in UNESCO for the exchange of personnel and for negotiations relating to agreements between Governments on scientific matters.

97. In support of these organizations and activities on the international scene, it would also be desirable to have national committees concerned with space activities in the individual countries; appropriate steps to encourage this should be taken.

VI. AREAS OF SPACE ACTIVITY IN WHICH INTERNATIONAL CO-OPERATION SHOULD BE STRENGTHENED

A. Conduct of space science

98. Advances in scientific knowledge are usually made by individual specialists or small groups who have reached the frontiers of knowledge in quite a narrow field. By way of example, if one considers such a frontier as the source and nature of the ionization of the upper atmosphere, the number of leading research workers in such a field is by no means too large for the personal exchange of views at meetings or by correspondence. A century ago it would have been only a few individuals who corresponded or met occasionally for a philosophical exchange of ideas or results. As the numbers grew, scientific organizations became desirable and since their aim was the advancement of knowledge which knows no national boundaries, scientific organization necessarily was cosmopolitan and soon became international in character. Many such organizations now exist and form the group of international scientific unions represented in ICSU. It must be emphasized that these unions matured only when the demand for them had grown. Thus, though their organization had been carefully worked out, the need was very apparent before the plan matured.

99. Even with these organizations, actual co-operative projects are often and very effectively carried out between interested and enthusiastic individuals or groups who have studied each other's publications, and, after meeting occasionally to exchange views, have decided to undertake a joint project. Where a national boundary exists between two such groups and an expenditure of money is involved, government approval or support may often be necessary. Such joint scientific activities, however, are by no means bilateral in the sense of excluding others. Their existence and nature is often known to interested colleagues elsewhere and the results are reported at scientific meetings. It may be expected that in the field of space research joint activities of this kind among specialized groups

will continue to be an important means of advance. As long as these activities are carried on in an orderly and open manner, they should be fostered and supported since they represent the normal methods of co-operation among colleagues.

100. It is against this background of scientific co-operation that the impact of space science and its possible application must be examined. It is evident that co-operation in space activities will require international organizations of several kinds, but it is necessary to determine these requirements area by area, examining to what extent present organizations are adequate and establishing what need there may be for extensions or additions.

101. The crucial question is thus how international co-operation in the peaceful uses of outer space should be fostered. For example, international co-operation in programmes employing sounding rockets for basic research should probably be carried out by an organization dealing with space research under the aegis of ICSU or a specific international scientific union, but an active interest on the part of the United Nations would probably be necessary to extend such a programme in due course from the experimental stage into common practical application. Such interest by the United Nations might be expressed by a recommendation that Member States encourage their national scientific centres to expand their international relations in the field of space science generally. Another way might be to ask the Secretary-General to keep the development of international co-operation in this specific field under review and report to the next session of the General Assembly on the progress made. Encouragement of this kind might be effected through the establishment of a special United Nations body charged with keeping under review the co-operative arrangements of international scientific organizations, specialized agencies and States, in order to be able to report on the development in breadth and depth of programmes for the exchange of scientists and experts. Alternatively, this body might be advisory to the Secretary-General in this and other matters relating to outer space, leaving to him to report to the General Assembly with recommendations.

102. The General Assembly in paragraph 1 (b) of resolution 1348 (XIII), asked for something more than a review of these areas where international co-operation is feasible. It referred expressly to the consideration of programmes of co-operation in the field of outer space under the auspices of the United Nations and did not envisage the limitation of programmes of international co-operation to non-governmental organizations.

103. While the Committee is of the belief that the world does not yet need an international agency for outer space, there is an evident need for efforts of co-ordination and encouragement by the United Nations in some areas by way of support for international co-operation in this field.

2. Promotion of scientific activities in this field

104. Where the objective is scientific, whether academic or applied, regulatory provisions requiring agreements among Governments are necessary only peripherally to promote scientific co-operation. Most needs are cared for successfully by the international scientific unions.

105. Exploration into the unknown, such as those symbolized by space probes, are well covered by the activities of the international scientific unions and their affiliated bodies. Through their services, the scientific community exchanges views and ideas, circulates reasonable amounts of information, or establishes co-operation at various levels of formality. The administration of the international scientific unions is largely based on voluntary work by active scientists, supported by a minimum of professional staff. For example, the cost of the entire international administration of the International Geophysical Year for the administrative period 1952-1959 is estimated at less than $250,000.

106. The international scientific unions devote themselves to progress and consolidation in the advancing parts of science; they are less concerned with technical applications of established knowledge, or programmes of broader education and information. Their administrative structure of periodic assemblies and committee meetings, and to a lesser extent of permanent, large agencies, constitutes an inherent limitation on the consideration of problems of a longer range as distinct from day-to-day actions.

107. The expansion of activities into outer space was initiated during the International Geophysical Year and the first steps towards co-operation were part of that programme. It must be realized, however, that activities in outer space now expand at such a rate and into so many fields that the international scientific unions must share the load of international organization in this whole field with a number of other and different international organizations, such as those dealing with engineering and telecommunications.

108. Amongst typical topics falling well within the scope of the international scientific unions can be cited: (a) to plan and co-ordinate general programmes for earth satellites and space probes; (b) to stimulate research supporting space science; and (c) to plan and co-ordinate simultaneous launchings of rockets in many parts of the world. The possibility of directing the attention of scientists from many different specialities to common problems in space exploration is a particularly valuable feature of the international scientific unions.

Development of national scientific capabilities in this field

109. It was mentioned earlier that scientific work in outer space involves no new scientific disciplines in the present epoch. Space vehicles are vehicles designed purely to carry instruments or living organisms into parts of the earth's environment which could not previously be reached. Previous knowledge of such regions had to be deduced from indirect measurements. The present objective is to use space vehicles to advance knowledge in the fields of physics, geophysics, astronomy, chemistry and biology related to the environment in which the earth moves. A number of applications have been discussed, those nearest achievement being in meteorology and communications. When these have crystallized out of the research stage, a technology will develop and their application spread into common use.

110. In such applications, particularly in meteorology, both sounding rockets and satellites may be used. The development and use of the sounding rocket by several countries, large and small, shows that the use of this vehicle is not limited to countries having the greatest technological facilities. As they are used they will become cheaper and available to even more countries. The need for world-wide coverage of atmospheric studies at altitudes between about 30 kilometres and 200 kilometres will make international co-operation among many countries a necessity as soon as these applications have reached an appropriate phase.

111. There can be no monopoly of the research activities that are a part of space science. It is perhaps useful to point out also that no country could possibly have a monopoly on the production of scientists capable of making contributions in the specialized branches of science that are involved. These include atmospheric physics, ionospheric physics, aurora studies, meteor studies,

many branches of astrophysics, and the physics, psychology and biology of unsual environments.

112. Earlier sections of this report have emphasized that the majority of the problems involved in these disciplines are still in the research stage; that there is need for work in them all over the world; and that laboratory work and theoretical work done on the ground on a small scale at no great cost can make important contributions which are required in the scientific utilization of satellites and space probes, although it is true that the launching of these is likely to remain for some time to come a preserve of the countries with the greatest technical facilities.

113. In any scientific endeavour the most effective way to learn is by experience, particularly in co-operation with those active in the field. Some of the countries active in space science offer fellowships and visiting professorships which may be held in government supported laboratories or universities where research in space is undertaken. Since no new basic science is involved, the requirements for any country to start research in space science are to assist its trained scientists in the fields of physics, geophysics, astronomy or biology, in visiting centres of active space research in these fields, and to give them some facilities and time in their home institutions to undertake original work.

114. It is quite possible that the opportunities for visits and exchange of personnel are now adequate. In spreading information about opportunities for participation in space activities to many States not now taking part, and in the provision of material for wide-spread education, UNESCO occupies a key position.

115. Discussions indicate that there is need for a greater and more up-to-date exchange of scientific information, preferably through existing channels, which, however, require clearing and broadening. The arrangment of symposia on certain aspects of space science is also an important activity, to which UNESCO's attention might be drawn. These are projects best undertaken by organizations of the type of the international scientific unions which co-operate with UNESCO. Because the effects of space developments concern all mankind, it is essential that opportunities for co-operation and extensive distribition of information be made available to all countries, irrespective of the state of their scientific and economic development.

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116. States with capabilities for launching satellites should be supported in including in them scientific experiments devised by other countries. The international scientific unions could properly play an important role in this kind of co-operation.

117. National contact with non-governmental international scientific organizations is normally made through academies or research councils recognized as the appropriate bodies to advise their Governments. More efficient contact between scientists in different countries can be furthered through the formation of national committees on space science. Such bodies could build on the experience of IGY national committees.

B. Application of the results of space science

118. As discussed in paragraphs 22 to 40, foreseeable applications in the field of outer space include the following: meteorological satellites, communications satellites, television and broadcasting satellites, geodetic satellites, and navigation satellites.

119. The foregoing activities will need an ever increasing degree of inter-governmental agreement.

120. Such inter-governmental scientific and technical agencies as WMO, ITU and its affiliated committees, ICAO and others, are the important channels for international co-operation in this field. Their attention is partly directed towards maintaining order in the conduct of many kinds of international activities, such as radio communication, the enormous data exchanged between weather services and others; in part it is also directed towards planning and preparation when new techniques are maturing to the stage where they can be put into practical application. Their experience in these fields should be brought to bear urgently on space activities.

C. The open and orderly conduct of space activities

121. From the description and analysis of the various aspects of peaceful uses of outer space, certain common lines emerge, and one can discern the outlines of a pattern, still sketchy and incomplete, but worth elaborating.

122. In all projects there is an emphasis placed on the need for systematic and regular description of progress, exchange of information stage by stage, and adherence to certain agreed rules. It is necessary to improve the means for the distribution and assimilation of knowledge about space activities throughout the world, so that there can be no doubt of the orderly character of such activities, and so that all countries may have the opportunity to take part in them irrespective of the state of their scientific and economic development.

123. Reviewing the wealth of present projects from this angle, some typical examples can be quoted.

124. A regular census of satellites which are circling the earth must be maintained. Their number will become considerable in the near future and they will ultimately be useful to many countries (see paragraphs 22-40 and 93-94). The register should contain data about orbits and radio transmission (see paragraphs 69-70); it will soon be useful to make periodic reviews of the position in order to agree when an individual satellite's useful life is ended and on the action to be taken to terminate its radio transmission or to remove the satellite (see paragraphs 71-72). Tracking of space vehicles and radio recording of data depend entirely on orderly procedures (see paragraphs 59-64).

125. International plans for the wide-spread use of sounding rockets to moderate heights have already been carried out (see paragraph 77). Their scope is widening (see paragraphs 15-17 and 24-30), spreading into further applications and to many countries. Looking into the future, thought might be given to the creation of international launching centres for sounding rockets (see paragraphs 78-79).

126. Re-entry and recovery of space vehicles returning to the earth are techniques in the course of perfection and calling for co-operation (see paragraphs 73-75). Such re-entry may also involve the execution of international agreements, based on legal considerations, about procedures for dealing with information relating to the territories of many countries and of common benefit (see paragraphs 39-40).

127. Channels of information must be maintained and broadened to serve scientists already working on problems of outer space (see paragraphs 80-85, 89 and 104-108) to bring in new groups of scientists and students (see paragraphs 92 and 109-117) and to inform the general public reliably and effectively.

128. This set of examples, which is not exhaustive, shows that a principle of open and orderly conduct lies at the root of international co-operation directed towards the peaceful use of outer space. Adherence to this principle would further the progress of space science and technology, both in the narrow sense as activities in themselves, and in their relation to human progress. Such experience is not new, but is common to co-operation in any branch of science; as one example, it guided the success of the recent International Geophysical Year.

129. Another feature is also apparent. Space activities have wide implications, spreading beyond pure science into technical applications, international co-operation, and effects on the world at large. These implications involve many international organizations covering a wide range of interests, such as scientific societies, government organizations, international news services, etc.

130. This wide dispersion calls for a rallying point related to the United Nations, small in size and well informed. There exists already a variety of organizations to carry heavy loads of work in different areas of space activity, but there is a need for a centre, to which inquiries can be directed at any time, and by which information can be communicated effectively to the appropriate body in much the same way as ICSU meets a similar need for the existing international scientific unions.

131. Such a small central body, with expert technical knowledge, would have to act in intimate contact with existing technical agencies and international organizations. Starting modestly, its work would be directed to assisting and correlating the many efforts towards open and orderly conduct of space activities. As a corollary, it would naturally serve as a means for current summary of the position in this rapidly expanding field. Thereby it would provide a most useful continuing service for any panel of experts which from time to time might meet for more extensive reviews.

VII. GENERAL CONCLUSIONS

132. As the first technical area in which immediate international action is required, the Committee calls attention to the conclusion regarding allocation of radio frequencies for space activities.

133. On the basis of the specific conclusions reached in previous sections of this report and listed in paragraphs 13 and 14, the following general conclusions have emerged:

(1) There is a need for a suitable centre related to the United Nations that can act as a focal point for international co-operation in the peaceful uses of outer space.

(2) Progress, plans and needs in connexion with the peaceful uses of outer space should be reviewed again by the United Nations in about one year.

PART III

(PARAGRAPH 1(d) OF GENERAL ASSEMBLY RESOLUTION 1348 (XIII))

I. INTRODUCTION

A. Mandate of the Committee

1. The task of the Ad Hoc Committee on the Peaceful Uses of Outer Space under paragraph 1(d) of General Assembly resolution 1348 (XIII) is to report on:

> "The nature of legal problems which may arise in the carrying out of programmes to explore outer space."

2. The scope of the mandate thus given the Committee was the subject of discussion. It was recognized that the terms of reference of the Committee referred exclusively to the peaceful uses of outer space. One view expressed was that the task of the Committee related only to the identification and listing of legal problems which might arise in the carrying out of programmes to explore outer space and that the Committee was not called upon to formulate either general or particular solutions of those problems. Another view was that the Committee, in identifying and listing the problems, should give some indication of the significance and implications of each problem and the priority which might be given to its solution. Others stressed the importance of giving attention to certain relevant general principles, such as those contained in the preamble and operative paragraph 1 (b) of resolution 1348 (XIII). It was also pointed out that, while paragraph 1 (d) of resolution 1348 (XIII) referred only to problems which might arise in the exploration of outer space, it was not always possible in relation to certain activities to differentiate between exploration and exploitation of outer space and that both the exploration and the exploitation of outer space were expressly mentioned in the preamble to the resolution.

3. The Committee recognized that it would be impossible at this stage to identify and define, exhaustively, all the juridical problems which might arise in the exploration of outer space. Recognizing the multiplicity of these juridical problems, the Committee considered that it could most usefully fulfil its mandate from the General Assembly, in view of the complex character of these problems, by:

(1) selecting and defining problems that have arisen, or are likely to arise in the near future, in the carrying out of space programmes; (2) dividing the problems into two groups, those which may be amenable to early treatment and those which do not yet appear to be ripe for solution; and (3) indicating, without definite recommendation, various means by which answers to such problems might be pursued. The identification of legal problems entails, of necessity, some consideration of possible approaches to their solution, particularly with a view to presenting the best informed comment that can be made on the matter of priorities.

B. General observations

4. The Committee considered the relevance to space activities of the provisions of the United Nations Charter and of the Statute of the International Court of Justice, which synthesized the idea of co-operation between men and the joint achievement of great projects for the benefit of all mankind; it observed that as a matter of principle those instruments were not limited in their operation to the confines of the earth. It considered as a worthy standard for international co-operation and programmes in the peaceful uses of outer space which could appropriately be undertaken under United Nations auspices, to the benefit of States irrespective of the state of their economic or scientific development, the principles set forth in the operative paragraph 1 (b) and the preamble of resolution 1348 (XIII), in which the General Assembly called attention to Article 2, paragraph 1, of the Charter which states that the Organization is based on the principle of the sovereign equality of all its Members, recognized the common interest of mankind in outer space and the common aim that it should be used for peaceful purposes only, and expressed the desire of promoting energetically the fullest exploration and exploitation of outer space for the benefit of mankind.

5. It was unanimously recognized that the principles and procedures developed in the past to govern the use of such areas as the air space and the sea deserved attentive study for possibly fruitful analogies that might be adaptable to the treatment of legal problems arising out of the exploration and use of outer space. On the other hand, it was acknowledged that outer space activities were distinguished by many specific factual conditions, not all of which were now known, that would render many of its legal problems unique.

6. The Committee agreed that some of the legal problems of outer space activities were more urgent and more nearly ripe for positive international agreement than others. It was felt that the progress of activities in outer space and of advances in science and technology would continually pose new problems relevant to the international legal order and modify both the character and the relative importance of existing problems. For example, future arrangements among Governments or private groups of scientists for co-operation in space research or dissemination of space data may entail legal problems ranging from administrative or procedural arrangements to regulation or control. The Committee noted the indispensable usefulness of close and continuous co-operation between jurists and scientists to take these and other developments into account.

7. The Committee considered that a comprehensive code was not practicable or desirable at the present stage of knowledge and development. Despite the progress already made, it was emphasized that relatively little is so far known about the actual and prospective uses of outer space in all their possible varieties of technical significance, political context, and economic utility. It was pointed out that the rule of law is neither dependent upon, nor assured by, comprehensive codification and that premature codification might prejudice subsequent efforts to develop the law based on a more complete understanding of the practical problems involved. Although an attempt at comprehensive codification of space law was thought to be premature, the Committee also recognized the need both to take timely, constructive action and to make the law of space responsive to the facts of space.

8. For these reasons it was agreed that the rough grouping of legal problems according to the priority hereafter suggested should itself be kept under regular review by whatever means the General Assembly should deem fitting.

II. LEGAL PROBLEMS SUSCEPTIBLE OF PRIORITY TREATMENT

A. Question of freedom of outer space for exploration and use

9. During the International Geophysical Year 1957-1958 and subsequently, countries throughout the world proceeded on the premise of the permissibility of the launching and flight of the space vehicles which were launched, regardless of

what territory they passed "over" during the course of their flight through outer space. The Committee, bearing in mind that its terms of reference refer exclusively to the peaceful uses of outer space, believes that, with this practice, there may have been initiated the recognition or establishment of a generally accepted rule to the effect that, in principle, outer space is, on conditions of equality, freely available for exploration and use by all in accordance with existing or future international law or agreements.

B. Liability for injury or damage caused by space vehicles

10. Since injury or damage might result from the launching, flight and return to earth of various kinds of space vehicles or parts thereof, a number of problems exist with respect to defining and delimiting liability of the launching State and other States associated with it in the space activity causing injury or damage. First of all there is the question of the type of interest protected: that is, the kind of injury for which recovery may be had. Second, there is the question of the type of conduct giving rise to liability: should liability be without regard to fault for some or all activities, or should it be based upon fault? Third, should a different principle govern, depending on whether the place of injury is on the surface of the earth, in the air space or in outer space? Fourth, should liability of the launching State be unlimited in amount? Finally, where more than one State participates in a particular activity, is the liability joint or several?

11. What machinery should be utilized for determining liability and ensuring the payment of compensation if due? The Committee considered that early consideration should be given to agreement on submission to the compulsory jurisdiction of the International Court of Justice in disputes between States as to the liability of States for injury or damage caused by space vehicles.

12. When it considered the foregoing questions, the Committee noted that, in so far as concerns liability for surface damage caused by aircraft, there was formulated at Rome in 1952, under the aegis of ICAO, the Conventon on Damage Caused by Foreign Aircraft to Third Parties on the Surface. In the opinion of the Committee, that Convention and ICAO experience in relation thereto could be taken into account, inter alia, in any study that might be carried out in the future concerning liability for injury or damage caused by space vehicles. It

was pointed out, however, that no international standards regarding safety and precautionary measures governing the launching and control of space vehicles had yet been formulated, and this fact also could be taken into account in studying analogies based on existing conventions.

C. Allocation of radio frequencies

13. It was recognized that there are stringent technical limits on the availability of radio frequencies for communications. The development of space vehicles will pose new and increasing demands on the radio spectrum. It was emphasized that rational allocation of frequencies for communications with and among space vehicles would be imperative. In this way, what might otherwise come to constitute paralysing interference among radio transmissions could be avoided.

14. Attention was drawn to the fact that there is already in existence and operation an international organization suited to the consideration of problems of radio frequency allocation for outer space uses, namely, ITU. A technical committee of this organization has already issued a recommendation and a report which bear the following titles: "Selection of Frequencies Used in Telecommunication with and between Artificial Earth Satellites and other Space Vehicles" and "Factors Affecting the Selection of Frequencies for Telecommunication with and between Space Vehicles". The findings contained in these two documents will be presented to the Administrative Radio Conference of ITU which will open in Geneva on 17 August 1959.

15. Attention should also be given to the desirability of terminating transmissions from space vehicles once these transmissions have outlived their usefulness. Such a measure would help conserve and make optimum use of the frequencies which are assigned for outer space communications. In considering this problem, it would be necessary to balance this factor against the interest in conserving a means for continuous identification of space vehicles.

D. Avoidance of interference between space vehicles and aircraft

16. As the launchings of space vehicles become more numerous and wide-spread throughout the world, practical problems will clearly arise in regard to the prevention of physical interference between space vehicles, particularly rockets,

and conventional aircraft. The latter are already employed in great numbers across the earth and in many areas air traffic is already congested. It was considered that Governments could give early attention to the problem of interference between aircraft and space vehicles and that technical studies could usefully be undertaken, if necessary with the assistance of competent specialized agencies.

E. Identification and registration of space vehicles and co-ordination of launchings

17. It is expected that the number of space vehicles will progressively increase. In the course of time, their numbers may become very large. This indicates the necessity of providing suitable means for identifying individual space vehicles. Such identification of space vehicles could be obtained by agreement on an allocation of individual call signs to these vehicles; the call signs could be emitted at stipulated regular intervals, at least until identification by other means had been established. Another means of identification is by orbital or transit characteristics of space vehicles.

18. As part of the problem of identification, there arises the question of placing suitable markings on space vehicles so that, particularly in the event of their return to earth, they may be readily identified.

19. Identification would be facilitated by a system of registration of the launchings of space vehicles, their call signs, markings and current orbital and transit characteristics. Registration would also serve a number of other useful purposes. For one example, one serious problem is the potential overloading of tracking facilities. Registration of launchings would help to avoid this. Registration might also afford a convenient means for the notification of launchings to other States, thus enabling them to make appropriate distinctions between the space vehicles so notified and other objects, and to take appropriate measures to protect their interests if necessary.

20. A further measure, beyond registration, would be agreement on the co-ordination of launchings.

F. Re-entry and landing of space vehicles

21. Problems of re-entry and landing of space vehicles will exist both with respect to unmanned space vehicles and later with respect to manned vehicles of exploration. Where space vehicles are designed for re-entry and return, it will be appropriate for the launching State to enter into suitable arrangements with the State on whose territory the space vehicle is intended to land and other States whose air space may be entered during descent. Recognizing, moreover, that such landings may occur through accident, mistake or distress, members of the Committee called attention to the desirability of the conclusion of multilateral agreements concerning re-entry and landing, such agreements to contain suitable undertakings on co-operation and appropriate provisions on procedures. Among the subjects that might be covered by such agreements would be the return to the launching State of the vehicle itself and - in the case of a manned vehicle - provision for the speedy return of personnel.

22. It was also considered that certain substantive rules of international law already exist concerning rights and duties with respect to aircraft and airmen landing on foreign territory through accident, mistake or distress. The opinion was expressed that such rules might be applied in the event of similar landings of space vehicles.

III. OTHER PROBLEMS

A. Question of determining where outer space begins

23. Under the terms of existing international conventions and customary international law, States have complete and exclusive sovereignty in the air space above their territories and territorial waters. The concurrent existence of a region in space which is not subject to the same regime raises such questions as where air space ends and where outer space begins. It was noted that these limits do not necessarily coincide. While they have been much discussed in scholarly writing, there is no consensus among publicists concerning the location of these limits.

24. A view was expressed that it might eventually prove essential to determine these limits. The Committee reviewed a number of possibilities in this connexion, including those based upon the physical characteristics of air and of aircraft. The difficulties involved were agreed to be great. An authoritative answer to the problem at this time would require an international agreement, and the opinion was expressed that such an agreement now, based on current knowledge and experience, would be premature. It was considered that, in the absence of an express agreement, further experience might lead to the acceptance of precise limits through a rule of customary law.

25. In the absence of a precise demarcation, another possible approach would be to set tentatively, on the basis of present experience and knowledge, a range within which the limits of air space and outer space would be assumed to lie. It was suggested that an approach of this kind should avoid a boundary so low as to interfere with existing aviation regimes or so high as unreasonably to fetter activities connected with the use and exploration of outer space.

26. There was also discussion as to whether or not further experience might suggest a different approach, namely, the desirability of basing the legal regime governing outer space activities primarily on the nature and type of particular space activities.

27. One development might be the conclusion of inter-governmental agreements, as necessary, to govern activities sufficiently close to the earth's surface and bearing such a special relationship to particular States as to call for their consent. Each such agreement could contain appropriate provisions as to the permissibility of a given activity by reference not only to altitude and "vertical" position but also to trajectory, flight mission, known or referred instrumentation, and other functional characteristics of the vehicle or object in question.

28. It was generally believed that the determination of precise limits for air space and outer space did not present a legal problem calling for priority consideration at this moment. The Committee noted that the solution of the problems which it had identified as susceptible of priority treatment was not dependent upon the establishment of such limits.

B. Protection of public health and safety: safeguards against contamination of outer space or from outer space

29. The Committee took note of the apprehensions that have been expressed that activities in outer space might bring to those regions, by inadvertence, living or other matter from the earth capable of interfering with orderly scientific research. It was agreed that further study should be encouraged under appropriate auspices to specify the types of risks, the gravity of dangers, and the technical possibility, as well as the cost, of preventive measures. Such study should also cover safeguards against similar contamination of the earth as a result of space activities as well as protection against other hazards to health and safety that might be created by the carrying out of programmes to explore outer space. These studies could be undertaken with a view to the possible formulation of appropriate international standards.

C. Questions relating to exploration of celestial bodies

30. The Committee was of the view that serious problems could arise if States claimed, on one ground or another, exclusive rights over all or part of a celestial body. One suggestion was that celestial bodies are incapable of appropriation to national sovereignty. Another suggestion was that the exploration and exploitation of celestial bodies should be carried out exclusively for the benefit of all mankind. It was also suggested that some form of international administration over celestial bodies might be adopted.

31. The Committee noted that, while scientific programmes envisaged relatively early exploration of celestial bodies, human settlement and extensive exploitation of resources were not likely in the near future. For this reason the Committee believed that problems relating to the settlement and exploitation of celestial bodies did not require priority treatment.

D. Avoidance of interference among space vehicles

32. It was agreed that, apart from problems of communications and overloading of tracking facilities, there was for the present little danger of interference of space vehicles with each other. It was pointed out that this situation might

change in time, particularly if vehicles in space are used extensively for either global or interplanetary travel. There was discussion about the possible relevance to space travel of rules and experience developed in relation to air traffic. It was decided that more scientific information would be needed before rules could be drafted.

E. Additional questions raising legal problems

33. The Committee recognized that various other technical developments would probably call for legal arrangements and regulation. Particular reference was made in this connexion to meteorological activities in outer space which may require international measures to insure maximum effectiveness.

PART IV

(PARAGRAPH 1 (c) OF GENERAL ASSEMBLY RESOLUTION 1348 (XIII))

I. MANDATE OF THE COMMITTEE UNDER PARAGRAPH 1 (c) OF RESOLUTION 1348 (XIII)

1. The task of the Ad Hoc Committee on the Peaceful Uses of Outer Space under paragraph 1 (c) of General Assembly resolution 1348 (XIII) is to report on:

> "The future organizational arrangements to facilitate international co-operation in this field within the framework of the United Nations."

2. The Ad Hoc Committee felt that its report under this paragraph should briefly survey the types of organizational arrangements which were possible within the framework of the United Nations, and relate these to studies made by the Committee in connexion with paragraphs 1 (a), 1 (b) and 1 (d) of resolution 1348 (XIII). In performing this task the Committee was cognizant of the fact that these studies pointed to the need for continued study and review in this rapidly advancing field.

II. ORGANIZATIONAL POSSIBILITIES

3. There are a number of possible organizational arrangements within the framework of the United Nations.

A. United Nations agencies

4. The most elaborate and comprehensive organizational arrangement for facilitating international co-operation is the creation of a specialized agency. A specialized agency is an autonomous inter-governmental organization whose constitution is the product of international convention appropriately ratified by Member States. The entity thus created is brought into relationship with the United Nations, under Articles 57 and 63 of the Charter, through an agreement negotiated between the Economic and Social Council and the agency which is approved by the General Assembly. Such an organization reports annually on its activities to the Economic and Social Council.

5. Specialized agencies are contemplated by the Charter and are accorded certain privileges; they may, for example, be given the right by the General Assembly to refer questions to the International Court of Justice, and they automatically become members of inter-secretariat bodies such as the Joint Pension Fund and the Administrative Committee on Co-ordination. They maintain, however, their status as autonomous inter-governmental organizations, and they have responsibility for such activities as budgetary arrangements, staff rules and regulations, and rules of procedure.

6. Examples of specialized agencies now in existence which have some interest in outer space are UNESCO, ITU, WHO, WMO and ICAO. Those, as well as other agencies not so clearly interested in space activities, differ widely one from another in character of functions and in relationship to the United Nations.

7. The scope and nature of the functions of these agencies suggest the possibility of a comparable United Nations agency to deal with space activities. However, the tasks recommended in accompanying sections of this report would not appear to require the present establishment of a United Nations agency, with a professional staff, to co-ordinate and supplement other efforts, public and private, in international space co-operation.

B. Semi-autonomous bodies within the United Nations

8. The General Assembly may, by resolution, establish semi-autonomous operating bodies within the United Nations with mandates or terms of reference established by the General Assembly. The chief executive officer of such a body has broad authority under his mandate but is administratively responsible to the Secretary-General. Three such bodies, with somewhat differing structure, are in existence: the Office of the United Nations High Commissioner for Refugees, the United Nations Children's Fund (UNICEF), and the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA).

9. In the case of UNICEF, the Director was appointed by the Secretary-General for an indefinite term, without reference to or approval of the General Assembly or the Economic and Social Council. His salary and those of his staff are paid for out of the UNICEF budget, which is based on voluntary contributions of Member States. For administrative purposes, however, the staff generally operates as any

other office of the United Nations Secretariat. The Executive Board of UNICEF is elected by the Economic and Social Council for definite terms.

10. In the case of the Office of the United Nations High Commissioner for Refugees the High Commissioner is appointed by the Secretary-General, with the approval of the General Assembly, for a limited term. The Director of UNRWA is appointed by the Secretary-General in consultation with an Advisory Commission but without reference to or approval of the General Assembly or the Economic and Social Council. In each case, there is an executive committee or advisory group. Financial arrangements also vary somewhat, the programme of the High Commissioner being financed partly from the regular United Nations budget and partly from voluntary contributions, whereas the UNRWA and UNICEF programmes are financed entirely by voluntary contributions.

11. If, at some future time, it was believed that an international agency with a small professional staff would be a useful addition to other co-operative efforts in space, a semi-autonomous body within the United Nations might be appropriate.

C. Performance of functions by existing specialized agencies

12. As is apparent from other parts of the report of this Committee, existing United Nations specialized agencies can perform various useful functions with regard to space activities. Thus, UNESCO, ITU, ICAO, WMO and WHO can all play a role in carrying out technical studies. It does not, however, seem that any of these agencies should be asked to undertake over-all responsibility for future arrangements to facilitate international co-operation in the field of outer space activities, although each can undoubtedly continue to play an important part within the area of its special competence and interest. Their functional interests should of course be welcomed and encouraged.

D. Other arrangements within the United Nations

13. The General Assembly may, by resolution, establish a permanent Committee, outline the work to be accomplished, and authorize the Secretary-General to employ appropriate personnel. This was done in the case of the Scientific Committee on

the Effects of Atomic Radiation and in the case of the Secretary-General's Advisory Committee on the peaceful uses of atomic energy. In the case of the former, the Committee itself is responsible for reporting to the General Assembly. In the case of the latter, the General Assembly resolution places this responsibility on the Secretary-General. Personnel of the United Nations supporting these two committees are members of the United Nations Secretariat and covered by all of its administrative orders. The activities and any outside assistance of experts is covered by the regular United Nations budget.

14. Another possibility would be for the General Assembly to ask the Secretary-General to establish a small technical unit within the Secretariat to carry out certain limited functions. Arrangements could also be made for the establishment of an expert advisory committee composed of representatives of interested specialized agencies and key scientists to assist the Secretary-General in the execution of any functions that might be assigned to the Secretariat.

III. CONCLUSIONS

15. The Ad Hoc Committee has felt that its report under paragraph 1 (c) should briefly survey the types of long-term organizational arrangements which are possible within the framework of the United Nations, and relate these to the reports made in connexion with paragraphs 1 (a), 1 (b) and 1 (d) of resolution 1348 (XIII). The findings in the reports on the reports on those paragraphs underline the importance already attached by the General Assembly to the common interest of mankind in outer space. While its studies fortify the belief expressed in General Assembly resolution 1348 (XIII), which stressed the need for vigour in the development of programmes of international co-operation in the peaceful uses of outer space, the Committee recognizes that continued study and review of the problem is necessary. Accordingly, the Committee has limited its conclusions to the steps toward such development to be taken at the present stage without taking a position on the longer-range measures.

16. The Committee believes that it would not be appropriate at the present time to establish any autonomous inter-governmental organization for international co-operation in the field of outer space. Likewise, the Committee considers that it would not be suitable to ask any existing autonomous inter-governmental organization to undertake over-all responsibility in the outer space field.

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17. The sections of this report dealing with legal and scientific aspects of the question of the peaceful uses of outer space suggest certain general functions and tasks that might appropriately be undertaken within the framework of the United Nations at the present time. These include:

(a) To provide a focal point for facilitating international co-operation with respect to outer space activities undertaken by Governments, specialized agencies and international scientific organizations;

(b) To study practical and feasible measures for facilitating international co-operation, including those indicated by the Ad Hoc Committee in its report under paragraph 1 (b) of the resolution;

(c) To consider means, as appropriate, for studying and resolving legal problems which may arise in the carrying out of programmes for the exploration of outer space;

(d) To review, as appropriate, the subject matter entrusted by the General Assembly to the Ad Hoc Committee in resolution 1348 (XIII).

18. The Committee believes that, for the most part, the questions involved under (b), (c) and (d) above may be such as to require consideration at the governmental level. The General Assembly, if it agrees with this conclusion, may wish to consider the establishment of an Assembly committee, composed of representatives of Member States and having such membership as the Assembly may decide, to perform these functions, to report to the General Assembly and to make recommendations as appropriate.

19. The Committee considers that the functions suggested in paragraph 17 (a) above, which primarily is intended to implement the conclusion of the Technical Committee that "there is a need for a suitable centre to which to play to the United Nations that can act as a focal point for international co-operation in the peaceful uses of outer space", are of a different character. These are functions of the type frequently entrusted to an international secretariat. The General Assembly may therefore wish to consider among other possibilities that of requesting the Secretary-General to organize a small expert unit within the Secretariat for this purpose. Because the precise character of such a Secretariat can be developed only in the light of experience and after consultation with the various bodies involved, it may be desirable to provide a means whereby the Secretary-General can avail himself of the advice and assistance of those directly concerned in this field.

20. Consideration might therefore be given to provision for a small advisory committee, advisory to the Secretary-General, which could include representatives of the appropriate specialized agencies, scientists designated by international scientific organizations, and representatives of Member States, as necessary.

21. It would be possible for the General Assembly to adopt some or all of the suggestions described in paragraphs 18, 19 and 20, in any combination it deems appropriate.

22. The Committee believes that it would be appropriate for existing specialized agencies to continue to pursue lines of endeavour within their competence in regard to outer space activities. The Committee believes that the General Assembly might ask these agencies to include in their reports to the United Nations information on their activities in connexion with outer space.
